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PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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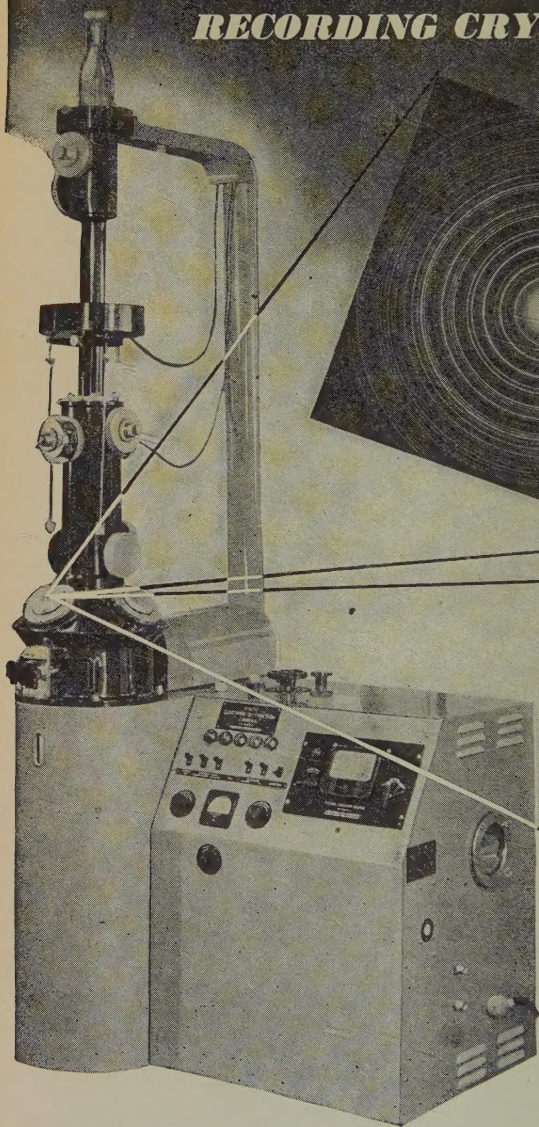
OCTOBER 1950

NUMBER 634

The FINCH

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- ... thin surface film of all kinds
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(Top)
Partly oxidised
tin foil, showing
typical transmission pattern
of a polycrystalline substance.

(Bottom)
Single crystal of silicon carbide.

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Industrial radiography	Photocells	Mechanical engineering
Electrical and magnetic measurements	Thermionic tubes	Illumination
and instruments	Cathode-ray tubes	Metallurgy
Electronic relays and counters	X-ray tubes	

LIST OF JOURNALS

The following list supplements that published with the January Number of Vol. 53 (1950). Journals marked * are not received regularly though abstracts of articles from them are occasionally published. The addresses given are believed to be correct, but no responsibility can be accepted for errors.

<i>Abh. Braunsch. Wiss. Gesell.</i>	<i>Abhandlungen der Braunschweigischen Wissenschaftlichen Gesellschaft</i> Geysostrasse 7, Brunswick.
<i>Astron.</i>	Formerly <i>Astr.</i> This contraction will henceforward be used for the word " <i>Astronomical</i> ."
<i>Aust. J. Sci.</i>	<i>Australian Journal of Science.</i> Science House, 157 Gloucester Street, Sydney.
* <i>Blast Furn.</i>	<i>Blast Furnace.</i> [Abstracted by Metropolitan-Vickers Electrical Co.]
* <i>Bol. Radiactividad.</i>	<i>Boletin de Radiactividad.</i>
* <i>Jap. J. Astr. Geophys.</i>	<i>Japanese Journal of Astronomy and Geophysics.</i>
* <i>N.Z. Sci. Congr.</i>	<i>Reports of The 6th Scientific Congress, New Zealand</i> (1947). Being Part V of Vol. 77 of the <i>Transactions of The Royal Society of New Zealand</i> , Victoria University College, P.O. Box, 1580, Wellington, C.1.
* <i>Pakistan J. Sci. Res.</i>	<i>Pakistan Journal of Scientific Research.</i>
* <i>Pwr Engng</i>	<i>Power Engineering.</i> [Abstracted by Metropolitan-Vickers Electrical Co.]
<i>Rensselaer Polytech. Inst. Bull., Engng Sci. Ser.</i>	<i>Rensselaer Polytechnic Institute Bulletin, Engineering and Science Series.</i> Publications Department, Rensselaer Polytechnic Institute, Troy, New York.
<i>Spectrochim. Acta</i>	<i>Spectrochimica Acta.</i> Butterworth-Springer, 436 Strand, London, W.C.2. [Change of address.]
* <i>Z. Metallkde</i>	<i>Zeitschrift für Metallkunde.</i> [Abstracted by <i>Applied Mechanics Reviews</i> .]

NEW JOURNALS

<i>Fortschr. Radiotech.</i>	<i>Fortschritte der Radiotechnik. Archiv für radiotechnische Neuerungen.</i> [Continuation of <i>Handbuch der Funktechnik</i> and <i>Fortschritte der Funktechnik</i> .] Franksche Verlagshandlung, Pfizerstr. 5-7, Stuttgart. Issue 1 (1950-51) appeared August (1950). Quarterly. Subscription per volume DM38.
<i>J. Atmos. Terr. Phys.</i>	<i>Journal of Atmospheric and Terrestrial Physics.</i> Butterworth Scientific Publications, 436 Strand, W.C.2. Academic Press Inc., 125 East 23rd Street, New York. Vol. 1. No. 1 appeared August (1950). Bi-monthly. Subscription per volume, including postage, £3 10s. 0d.; \$9.50.

ORIGINAL ARTICLES

It is regretted that the articles from which abstracts are made cannot be sent out on loan. Application should be made to appropriate lending libraries or to the publisher of the Journal concerned; publishers' addresses, where known, are given in the "List of Journals" published with the January Number of Vol. 53 (1950), or in the supplementary lists published subsequently.

ERRATA

- Abstr. 737, line 2: *for F. KAEMPFER read F. KAEMPFER.*
- Abstr. 1012, line 2: *for A. SUGIMITO read A. SUGIMOTO.*
- Abstr. 1267, line 3: *for "261" read "251".*
- Abstr. 1698, line 2: *for P. VINCENT read P. VIMONT.*
- Abstr. 3383, line 2: *insert B. L. FUNSHTEIN as second author.*
- Abstr. 4878, line 3: *for (Dec., 1949) read (Sept., 1949).*
- Abstr. 4904, line 16: *for "Be₂ crystals" read "a Be crystal".*

SCIENCE ABSTRACTS

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MATHEMATICS 51

3. **Three-dimensional rotations.** S. T. MA. *Peking Univ. Semi-Cent. Vol., Math. Phys. Ser.*, 60-80 (1948). 513.76
4. **Sommerfeld's polynomial method simplified.** RUBINOWICZ. *Proc. Phys. Soc., Lond. A*, 63, -71 (July, 1950). 517.9 : 530.145
- From two earlier papers by the author [Abstr. 5190 (49)] it follows that eigenfunctions obtainable by Sommerfeld's polynomial method contain either a Mann P -function or a degenerate form of it when the fundamental interval is either finite or infinite respectively. Comparing the differential equation for the function or its degenerate form with the differential equation which we get for P from the original differential equation of the eigenvalue problem, we obtain standard formulae for the constants determining the eigenvalues and eigenfunctions. The calculations necessary to give the complete solution of an eigenvalue problem, which can be treated by Sommerfeld's polynomial method, are thus reduced to a minimum of differentiations and simple algebraic operations. It is also possible using appropriately chosen P -functions to obtain the eigenfunctions directly in the required form. The method yields the eigenfunctions for eigenvalues in the continuous spectrum. A.
35. **An instrument for mechanically differentiating waves.** A. H. SCOTT. Note in *Rev. Sci. Instrum.*, 21, 7-8 (April, 1950). 518.5
36. **On the calculation of eigenvalues of matrices punched-card machines.** P. HENRICI. *Z. angew. Math. Phys.*, 1, 185-9 (May, 1950) In German. 518.5
37. **A differential analyzer for the Schrödinger equation.** R. L. GARWIN. *Rev. Sci. Instrum.*, 21, 1-16 (May, 1950). 518.5
- A rapid differential analyser of accuracy about 5% is discussed and its performance reviewed. Extensions to differential equations other than that of Schrödinger are mentioned. A.
38. **A new mechanical autocorrelator.** H. R. TWELL. *Rev. Sci. Instrum.*, 21, 481-4 (May, 1950). 518.5
- A relatively simple and inexpensive machine is described. The theoretical definition of the autocorrelation function is given. This is followed by an outline of the hand computational procedure as applied to observational (ocean wave) data of finite scope. The machine computation is next compared with the hand process. A.
39. **The EDSAC (Electronic delay storage automatic calculator).** M. V. WILKES AND W. RENWICK. *Math. Tables Aids Comput.*, 4, 61-5 (April, 1950). 518.5
- A short account which gives the Order Code and Control Sequence (1 photograph, 2 schematic diagrams). 518.5
6940. **Programme organization and initial orders for the EDSAC.** D. J. WHEELER. *Proc. Roy. Soc. A*, 202, 573-89 (Aug. 22, 1950).
- Orders for the machine are presented to it in coded form on punched tape, and are translated by the machine itself into the form in which they are held in the store, in accordance with a standard set of "initial orders". In the course of this input of orders it is possible to use the machine to make systematic modifications to the orders as punched on the tape; the modifications required, if any, are indicated by a code letter included in each order as punched on the tape. This system allows the use of a more flexible system of representing orders than the binary form used inside the machine. It also enables sub-routines to be drawn up in a form independent of the particular values of parameters in them, the values of these parameters in any particular application of the sub-routine being inserted by the machine in the course of the initial input of orders, or in the course of operation of the machine. This simplifies the formation of a library of sub-routines and its use in the construction of long programmes. A complete example is worked. A.
- 518.5 : 616.12-7
6941. **A trigonometric computer with electrocardiographic applications.** R. MCFEE. *Rev. Sci. Instrum.*, 21, 420-6 (May, 1950).
- An analogue computer has been built which determines $(e_1^2 + e_2^2)^{1/2}$ and $\text{Arc Tan } e_2/e_1$ 2 000 times a second with an accuracy of about 5%. Using amplified electrocardiographic voltages proportional to 3 perpendicular components of the dipole moment of the heart's electric field, a pair of computers of this type will be able to produce other voltages proportional to the magnitude and 2 directional angles of the dipole. This may simplify considerably the study of fluctuations in the direction of the dipole and the neutralization of the effects of abnormal heart positions. A.
- 518.5 : 621.318.572 : 681.142
6942. **BARK—a Swedish calculating machine.** *Tekn. Tidskr.*, 80, 193-4 (March 4, 1950) In Swedish.
- Numbers are represented by $a = 2^k \times p$, where k is a 6-digit integer and p a 24-digit fraction. The memory, arithmetic and control organs are described, with the in- and output, and 2 diagrams and a photograph are given. J. A. WILCKEN (R)
- 518.6
6943. **The numerical determination of biharmonic functions by an analogy method.** L. MALAVARD AND J. BOSCHER. *C.R. Acad. Sci., Paris*, 230, 1493-5 (April 24, 1950) In French.
- An experimental method for determining a biharmonic function satisfying prescribed boundary conditions is described. The function may be written

as $x\phi + \psi$, where ϕ and ψ are harmonic functions satisfying corresponding mixed boundary conditions. Treating ϕ and ψ as electric potentials, their values may be found by using 2 suitably designed electrolyte baths, and systematically adjusting the current supply to the electrodes until the boundary conditions on ϕ and ψ are satisfied to a sufficient approximation. The method has useful applications to plane elastic problems.

A. T. PRICE

519.2

6944. An extension of Wiener's theory of prediction. L. A. ZADEH AND J. R. RAGAZZINI. *J. Appl. Phys.*, **21**, 645-55 (July, 1950).

The theory of prediction described in this paper is essentially an extension of Wiener's theory. It differs from the latter in the following respects. (1) The signal (message) component of the given time series is assumed to consist of two parts, (a) a non-random function of time which is representable as a polynomial of degree not greater than a specified number n and about which no information other than n is available; and (b) a stationary random function of time which is described statistically by a given correlation function. (In Wiener's theory, the signal may not contain a non-random part except when such a part is a known function of time.) (2) The impulsive response of the predictor or, in other words, the weighting function used in the process of prediction is required to vanish outside of a specified time interval $0 \leq t \leq T$. (In Wiener's theory T is assumed to be infinite.) The theory developed in this paper is applicable to a broader and more practical class of problems than that covered in Wiener's theory. As in Wiener's theory, the determination of the optimum predictor reduces to the solution of an integral equation which, however, is a modified form of the

Wiener-Hopf equation. A simple method of solution of the equation is developed. This method can also be applied with advantage to the solution of the particular case considered by Wiener. The use of the theory is illustrated by several examples of practical interest.

519.2 : 537.52

6945. On the stochastic theory of continuous parametric systems and its application to electron cascade. H. J. BHABHA. *Proc. Roy. Soc. A*, **202**, 301-2 (Aug. 7, 1950).

A general theory is developed, applicable to the continuous parametric assemblies known in nature. It is applied, as an illustration, to the stochastic treatment of an electron cascade to derive the differential equations which determine the function from which the mean number of particles in an energy interval and the mean square deviation of the number can be calculated. It is shown in the appendix how the application of the usual method to the problem leads to the same results only if particular boundary conditions are imposed on the problem.

519.214 : 539.16.0

Some probability distributions connected with recording apparatus. II. See Abstr. 7455

519.2

6946. Statistical treatment of values of first 200 decimal digits of e and π calculated on the ENIAC. N. C. METROPOLIS, G. REITWIESNER AND J. VON NEUMANN. *Math. Tables Aids Comput.*, **4**, 109-1 (April, 1950).

No deviations from randomness were found for π but quite serious ones were disclosed for e .

519.283 : 539.185

Random sampling (Monte Carlo) techniques in neutron attenuation problems. I. See Abstr. 7521

ASTRONOMY . ASTROPHYSICS . GEODESY 52

522.25

6947. A new astronomical telescope. H. F. A. TSCHUNKO. *Veröff. Bad. Land Sternw., Heidelberg*, **15**, (No. 10) 93-9 (1949) In German.

A new mounting for observing between declinations $\pm 45^\circ$ with a fixed-location focus is discussed.

M. W. OVENDEN

522.6 : 530.12

6948. The Einstein shift at the eclipse of May 20, 1947, in Brazil. G. VAN BIESBROECK. *Astr. J.*, **55**, 49-53 (Jan., 1950).

The instrumental refinements described include the provision of a half-silvered flat to enable simultaneous recording of the eclipse field and the field at the same altitude 90° from the sun, the use of which was vitiated by the thermal distortion of the flat. Owing to unfavourable distribution of stars, the final result of $2.01''$ had a mean error of $\pm 0.27''$; the excess over the theoretical value of $1.745''$ is not considered established.

M. W. OVENDEN

523.11

6949. Spontaneous waves of gravitation and their harmonics. S. DOLINSKI AND E. GROZA. *C.R. Acad. Sci., Paris*, **230**, 1639-40 (May 8, 1950) In French.

523.11

6950. Cosmogonical problems and stellar energy. D. TER HAAR. *Rev. Mod. Phys.*, **22**, 119-52 (April, 1950).

This comprehensive survey includes discussions of the cosmogonies of Weizsäcker and Jordan. Detailed and critical accounts are given of recent theories of the origin of planetary systems, of the chemical elements and of cosmic rays. There is also a brief discussion of the production of energy in stars of different types.

R. A. NEWING

523.12

6951. Theory of the origin and relative abundance distribution of the elements. R. A. ALPHER AND R. C. HERMAN. *Rev. Mod. Phys.*, **22**, 153-212 (April, 1950).

The authors attempt a detailed summary of the present status and cosmological implications of the several theories. Details of the observed abundance distribution are discussed using, primarily, tabulations by Brown [Abstr. 1937, 2636 (1950)], but a critical analysis of the observations is not given. The history and basis of equilibrium theory is discussed. It is found unable to reproduce observed abundance

tribution unless variations of density and/or temperature with position occur in the equilibrium assembly; this leads to consideration of (a) formation of an isothermal material prestellar body in a radiation field, and (b) formation in dehydrogenized, collapsing giant stars. The identification of such stars with novae and supernovae does not appear to be either consistent with astrophysical knowledge or satisfactory for the theory. The equilibrium theory seems to be in contradiction with the observed isotopic abundances and the details of the abundance variations from element to element. The non-equilibrium theories show greater flexibility in that they require the specification of detailed nuclear processes (principally radiative neutron capture and intervening β -disintegration) and a definite cosmological model. In general, non-equilibrium theory is used to explain the observed distribution qualitatively and in some cases semi-quantitatively; existing anomalies may be resolved by the introduction of various secondary nuclear processes at present not considered. The authors find non-equilibrium theory attractive in its consistency with the picture of the early stages and present structure of a homogeneous, isotropic, expanding universe. The initial conditions demanded by the theories of (a) the fission of polynuclear complexes of stellar dimensions and (b) the "creation of matter" appear improbable to the authors. A bibliography of 180 references is included.

M. W. OVENDEN

523.161

52. The temperature of interstellar matter. III. L. SPITZER, JR. AND M. P. SAVEDOFF. *Astrophys. J.*, **111**, 593-608 (May, 1950).

For II, see Abstr. 5207 (1949). Detailed computations reveal a large difference of kinetic temperature T between H I, and H II regions. In observed H II regions T probably exceeds 7 500°K, a lower limit established by observations of [O II] λ 3727, and is probably not greater than 13 000°K. The theoretical computations give actual temperatures ranging between 5 000° and 10 000° near B stars and between 7 000° and 13 000° near O stars; the exact value depends on the ratio of C, N and O ions to protons and on the cross-section for electron excitation of these ions. In H I regions the sources of energy gain are relatively weak; the temperatures of clouds are reduced to about 60°K by three processes: electron excitation of the low-lying levels in C II and Si II, inelastic collisions between H atoms and grains, and inelastic collisions between H atoms and H_2 molecules. Even under somewhat extreme assumptions, the temperature in an H I cloud does not exceed 200°K. Values of the time t required to approach the equilibrium temperature are very short if the density is high. If the density of H atoms or ions is 10^2 per cm^3 , t is only about 10^2 years in both H I and H II regions. However, if the density of H atoms or ions is taken to be 10^{-2} , a value which may represent rarefied regions between clouds, the values of t are about 10^6 years in H II regions and 10^9 years in H I regions. As a result of the low temperatures found in H I clouds, the average charge on a dielectric interstellar grain is very small, but the potential may rise to several volts in H II regions.

A.

523.161 : 523.87
6953. Equivalent widths of interstellar calcium lines. L. SPITZER, JR., I. EPSTEIN AND LI HEN. *Ann. Astrophys.*, **13**, 147-63 (April-June, 1950).

High-dispersion spectrograms from the Mt. Wilson Observatory have been reduced to obtain equivalent widths of interstellar K and H lines for 141 stars. For 44 stars, measurements have been possible on several components of each line, produced by extinction in separate interstellar clouds.

A.

523.165 : 537.591

Cosmic radiation and radio stars. See Abstr. 7337

523.25

6954. On the compositions and structures of the planets. H. BROWN. *Astrophys. J.*, **111**, 641-53 (May, 1950).

The observed physical and chemical characteristics of the planets can be explained in a reasonably satisfactory manner by assuming that they condensed from a medium possessing varying temperatures and densities but fairly uniform composition. The conclusion is drawn that the inner planets possess nearly identical composition, the differences in density being largely the result of compression effects. Approximate models are derived for the major planets. It is found that Uranus, Neptune, Saturn and Jupiter possess, respectively, 3.1, 3.7, 6.4 and 9.1 earthlike cores and that nearly 70% of the mass of Saturn and 90% of the mass of Jupiter is composed of helium-hydrogen.

A.

523.4

6955. Perturbations of a satellite orbit. L. SPITZER, JR. *J. Brit. Interplan. Soc.*, **9**, 131-6 (May, 1950).

The motion of a small body, revolving in a nearly circular orbit around the earth about 800 km above the earth's surface, is considered. Perturbations by the sun and moon are negligible, causing the orbit to depart from a circle by less than one metre. Perturbations caused by the oblateness of the earth are much larger. An orbit nearly in the plane of the equator will not be distorted appreciably, but will precess in space; the pole of the orbit will move in a circle about the celestial pole, taking 55 days for a complete revolution. An orbit passing over the poles will deviate from a circle by 1.5 km, which is less than the deviations of the earth's surface from a sphere; the body will be 18 km higher above the earth's surface at the poles than at the equator.

A.

523.53

6956. The influence of high altitude winds on meteor trail ionization. C. D. ELLYETT. *Phil. Mag.*, **41**, 694-700 (July, 1950).

It is shown that the various types of range drifts observed in the long-duration radio echoes from meteor trails can be explained in terms of the influence of winds on the ionized column. A comparison of the characteristics of the fading of the radio waves returned from the ionosphere, with the characteristics of the fluctuations of the radio echoes from meteor trails, leads to the conclusion that some of the ionospheric phenomena may be due to meteor ionization in the E region.

A.

523.53 : 621.396.812.3 : 621.396.11
6957. The fluctuation and fading of radio echoes from meteor trails. J. S. GREENHOW. *Phil. Mag.*, **41**, 682-93 (July, 1950).

Subsequent to the initial diffraction phenomena the radio echoes exhibit fluctuations of period between 0.01 and 0.1 sec, when observed on radio-wave frequencies of 36 to 72 Mc/s. These fluctuations have been investigated simultaneously on 2 radio-wave frequencies and it is concluded that the phenomenon is due to wind gradients in the high atmosphere which cause the trail of meteor ionization to break up. In this way several reflecting regions are formed which give an interference pattern moving over the observing station.

A.

523.57
6958. Spectrum of a meteor train. P. M. MILLMAN. Letter in *Nature, Lond.*, **165**, 1013-14 (June 24, 1950).

A bright perseid meteor of visual magnitude -4 was observed photographically with a camera equipped with a rotating shutter. Approximate wavelengths and suggested identifications of ten lines of train spectrum are given, the lines falling into 2 groups, with durations of > 0.05 sec, or < 0.01 sec. The train spectrum differs from that of the meteor head in showing no ionized lines, and in the relative enhancement of lines of neutral elements arising from transitions to levels higher than the ground-state, supporting the hypothesis of the train being due to recombination in elements common in the light of the meteor. No evidence of N afterglow was found.

M. W. OVENDEN

523.671 : 535.338.4
6959. The band spectrum of CO^+ . II. Comet-tail system ($A^2\Pi - X^2\Sigma$). K. NARAHARI RAO. *Astrophys. J.*, **111**, 306-13 (March, 1950).

Pt. I, see Abstr. 4832 (1950).

523.72
6960. Damping and centre-limb-variation of the wings of the Mg series 3^1P-n^1D in the sun. H.-H. VOIGT. *Z. Astrophys.*, **27** (No. 1) 82-106 (1950) In German.

A detailed discussion of the measurement of the intensities of the wings is given. A comparison of the observations with the theoretical calculation of pressure damping with H and with electrons and ions leads to the conclusion that the electron pressure becomes more and more important for the higher members of the series. A relative concentration of $> 30\%$ for Mg is indicated. The centre-limb variation calculated from Minnaert's formulae and the theoretical damping is greater than that observed. A better agreement of theory with observation is obtained, if it is supposed that at deep layers the energy is transported primarily by convection.

M. W. OVENDEN

523.72
6961. From what depths does the solar radiation at different points of the disk, and for different wavelengths, originate? P. PROISY. *C.R. Acad. Sci., Paris*, **230**, 1577-9 (May 3, 1950) In French.

Extension of Unsöld's corresponding investigation referring to white light [*Physik der Sternatmosphären. Berlin* (1938) 95] to various colours between $\lambda 4260$

and $\lambda 8580 \text{ \AA}$. A discussion of the results with respect to the sun's radio emission is added.

A. BEER

523.746 : 538.1
6962. On the calculation of the magnetic fields of sunspots. E. G. V. ROKA. *Z. Astrophys.*, **27** (No. 1) 15-23 (1950) In German.

Investigation of the magnetic field above stationary sunspots with the methods of the potential theory. It is assumed that the field strength in the spot has rotational symmetry, and that there are no electric currents above the sun's surface where the field is measured. Each of the two components of the magnetic field strength defines the function which determines uniquely the field throughout space. This function is derived, and discussed on the basis of the available observational material. Two special models are examined in detail.

A. BEER

523.746.3
6963. On the origin of the sunspot period. W. GROTRIAN. *Naturwissenschaften*, **37** (No. 7) 16 (April, 1950) In German.

The relationship between the hypotheses of progressive (Alfvén, Walén) and standing (Schwarzschild, electromagnetic-hydrodynamic waves, and the "fundamental" theories of stellar magnetism (Wilson, Blackett, Chapman) is discussed in the light of the observed properties of the solar and sunspot fields.

M. W. OVENDEN

523.75
6964. The apparent asymmetry in the distribution of solar eruptions. M. WALDMEIER. *Z. Astrophys.*, **27** (No. 1) 56-7 (1950) In German.

A recent paper on this subject by F. Link and J. Kleczek [Abstr. 421 (1949)], which stated that the east side of the sun is richer in eruptions than the west side, is critically examined. Re-grouping the statistical data for the eruptive activity of a large sunspot group previously derived by the author [*Z. Astrophys.*, **16**, 276-90 (1938)], leads to the conclusion that the postulated effect is only spurious, caused by a selective factor in the material of active centres and by their asymmetrical evolution.

A. BEER

523.75
6965. On the fluctuations in the intensity of solar flares. G. RIGHINI. *Atti Accad. Naz. Lincei (R.C. Cl. Sci. Fis. Mat. Nat.)* **8**, 336-42 (April, 1950) In Italian.

The author derives development curves giving the variation of the effective line width of the H α lines for 29 solar flares (one of class 3, four of class 2, 24 of class 1) observed at Arcetri during the 2nd semester of 1949. The error of a single observation is at most $\pm 0.04 \text{ \AA}$ which accords well with those given by Ellison and Giovanelli. The irregular fluctuations of the line widths from the mean curve being greater than this error the author concludes that they represent actual irregularities in the intensity of the solar phenomenon. [The statement that solar flares "can be said with certainty (abstractors italics) to be a consequence of electromagnetic phenomena arising in the chromosphere" seems rather surprising.]

V. C. A. FERRARO

523.77
New solar lines in the spectral region 1.97–2.0 μ . L. GOLDBERG, O. C. MOHLER, A. K. PIERCE and R. R. McMATH. *Astrophys. J.*, **111**, 565–71 (May, 1950).

Measurements of wavelength and of percentage total absorption are given for 109 solar lines. Sixty-seven have been identified as arising from neutral atoms of H, Na, Si, Mg, Al, Ca and Fe. The relative scarcity of lines in the 2.2 μ region is discussed, and a qualitative explanation is given in terms of the variation with wavelength of the continuous absorption coefficient of H⁻ combined with the solar temperature gradient.

523.774
7. Solar excitation temperature of V 1. A. R. DODGE. *Astrophys. J.*, **111**, 575–9 (May, 1950).

The effect of temperature stratification in the solar atmosphere upon observed excitation temperatures has been investigated by constructing a theoretical curve of growth from line contours computed with Archard's model atmosphere. It is shown that for V 1 lines the predicted temperature is a function of excitation potential. A temperature of 5080°K is obtained from weak 0- to 3-volt V 1 lines. King and Wright's V 1 curve of growth is rediscussed, with corrections applied for the variation of the continuous absorption coefficient with wavelength. The determined curve gives a temperature of 5110° ± 100°K, which is in good agreement with the theoretical value.

523.775.2
8. The spectra of two active regions observed at sun's limb. R. S. RICHARDSON. *Astrophys. J.*, **111**, 572–4 (May, 1950).

Emission was observed in 109 lines between 3968 and 5903 Å in the spectrum of a prominence of the active sunspot type (Petit's class IIIc). Emission is observed in 126 lines from 3670 to 5900 Å in a range of intensity < 1. Atoms observed in the prominence and flare were H, He I, Na I, Mg I, Al I, Si I, Fe I, Ca II, Sc II, Ti II, Cr II, Fe II, Sr II, Y II and Ba II. The Balmer series appeared in emission in the flare to H 21, which is near the limit of transmission for the 75-ft spectrograph. The intensity of emission in lines of H and He was about the same in the prominence and the small flare, but most of the metallic lines appeared stronger in the prominence.

523.841.11
69. On the ejection of matter in novae after the maximum of brightness. E. R. MUSTEL. *Contr. Crimean Astrophys. Obs.*, **1** (Pt 2) 80 pp. (1948) In Russian.

This paper is an attempt to interpret physically the phenomena which lead to the change of the pre-maximum spectra into the spectrum which is dominant later. In the first chapter the forces which act in the extended reversing layer of a nova are considered with a special consideration to radiation pressure. The second chapter proposes the following model. Immediately before maximum light the photosphere reaches its maximum size and then begins to contract. Consequently, in the vicinity of the maximum a large velocity gradient is formed in the inner portions of the reversing layer so that even in the centres of

the absorption lines the atmosphere is almost transparent. Thus an increased selective radiation pressure begins to act on the inner layers of the shell. In the third chapter the author considers the processes which take place in the shell. A sub-shell β is formed which begins to move inside the original shell α (Fig. 5). Transformation of the α -shell into the β -shell explains the change of the pre-maximum spectrum into the principal spectrum. The fourth chapter makes a comparison with observations which are found to be quite satisfactory. The spectrum of N Her 1934 is studied in detail (Fig. 10) and the thickness of the shell is computed for it (60 $r_{\odot}$ for metals and 100 $r_{\odot}$ for hydrogen). In the fifth chapter the origin of the diffuse-enhanced and Orion spectrum is considered. Evidence is presented that we deal here with a continuous flow of matter which begins immediately after maximum. The sixth chapter treats the question of the origin of the secondary spectral characteristics in the spectra of novae. It is shown that here also the cause is to be found in increased selective radiation pressure.

ASTRONOMICAL NEWS LETTER

523.854.1
6970. Red nebulae in the Winter Milky Way. W. STROHMEIER. *Z. Astrophys.*, **27** (No. 1) 49–55 (1950). In German.

Description of 42 diffuse emission nebulae in the Winter Milky Way on the basis of photographs taken in the spectral region around H α , using a Schmidt camera (1:1.5; correction plate 10 cm diameter; 8° sky on 18 mm film); the limiting magnitude was about 13^m, the photometric accuracy 0.08^m. Extent, structure and brightness are tabulated. The hitherto most complete catalogue of diffuse bright nebulae by S. Cederblad [*Medd. Lund., Ser. II*, No. 119 (1946)] is supplemented by 18 new objects and 10 new magnitude values. It is shown that in general the red nebulae are concentrated in the Milky Way, and that their distribution and structure is similar to that of the violet emission nebulae.

A. BEER
 523.87 : 539.153
The oscillator strength for transitions and continua in Ca II. See Abstr. 7446–7.

523.873
6971. Comparison of the ultraviolet spectra of K_0 -giants of small and large velocities. G. R. MICZAIKA. *Z. Astrophys.*, **27** (No. 1) 1–14 (1950) In German.

For 13 K_0 giants belonging to different velocity groups the depths of 82 lines in the spectral range λ 3990– λ 4385 are compared. No differences are found. Photometric measurements near the C and the CN bands at λ 4215 suggest, however, increased CH and decreased CN absorption in the case of high-velocity stars, comparing them with stars of normal motions (as previously found by W. W. Morgan and collaborators).

A. BEER
 523.877
6972. Concerning the fundamental physical principles in the theory of radiative equilibrium in stellar atmospheres. E. R. MUSTEL. *Contr. Crimean Astrophys. Obs.*, **2** (1948) In Russian.

The author discusses the question of the appli-

cability of the Kirchhoff-Planck law to stellar atmospheres. Suppose that a stream of radiation with temperature T_{rad} passes through a layer with temperature T_{kin} ; it is assumed that $T_{kin} > T_{rad}$. An additional assumption is that the optical depth $\tau_v \gg 1$. It is shown then (at variance with usually accepted views) that owing to low values of n_e in stellar atmospheres the radiation intensity will satisfy the inequalities $I_v \ll B_v(T_{kin})$ or $I_v < B_v(T_{kin})$. This means that in stellar atmospheres the field of radiation at a given point has no close dependence on the kinetic temperature immediately around this point. Consequently the application of the Kirchhoff-Planck law to stellar atmospheres cannot be justified and the modern theory of radiative equilibrium should be revised. This is especially important when supergiants, extended atmospheres and outer layers of the sun are studied.

ASTRONOMICAL NEWS LETTER

523.877

6973. On a recent paper on radiative equilibrium by D. H. MENZEL and H. K. SEN. I. W. BUSBRIDGE. *Astrophys. J.*, **111**, 654-7 (May, 1950).

See Abstr. 29 (1950). The mathematics is shown to be unsound, the results being correct only in form. It is shown that all the results are obtained correctly by means of the operational calculus.

A.

523.877

6974. Sources of stellar energy and a theory of internal constitution of stars. N. A. KOZYREV. *Contr. Crimean Astrophys. Obs.*, **2** (1948) In Russian.

At the outset the author states that this is an attempt to solve the problem outlined in the title by an analysis of empirical laws deduced from astrophysical observations and not by methods involving *a priori* assumptions. His results, he says, are at variance with usual ideas on the internal structure of stars. His main conclusions follow: (1) radiation pressure does not play a significant role in any star, not even in a supergiant; it can be neglected in comparison with gas pressure; (2) the inner regions of stars are composed almost entirely of H (with a mean molecular weight near to $\frac{1}{2}$); (3) the absorption of light is caused by Thompson scattering produced by free electrons; (4) stellar structures closely resemble polytropic gas spheres with $n = \frac{3}{2}$. The combined results make possible approximate computations of physical conditions in stellar interiors, the observed L, M and R being used as a starting point. Thus a temperature of 6 million degrees is obtained for the centre of the sun, much too low for any thermonuclear reactions, he says.

ASTRONOMICAL NEWS LETTER

523.877

6975. The spectrum of white dwarfs and their energy supply. E. SCHATZMAN. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **25** (No. 7) 100 pp. (1950) In French.

Previous work is here collected together in an expanded form, the main features of white dwarf spectra being explained on the basis of a model whose exterior is almost entirely H on account of gravitational sorting of elements. Model atmospheres are constructed for 40 Erid B and for Van Maanen 2. Energy distribution in the spectrum background is

computed allowing for line broadening. Effect temperatures are found to be considerably higher for white dwarfs than for main sequence stars of same colour temperatures. Energy production explained in terms of the proton-proton reaction in the H envelope.

R. A. NEWBURY

523.3

6976. The dissipation of the corona and its significance. S. B. PIKELNER. *Dokl. Akad. Nauk, SSSR*, **72** (No. 2) 255-8 (1950) In Russian.

The dissipation of the corona is calculated by a kinetic method to be represented by the equation

$$N = \int_{R_\odot}^{\infty} Z_p \Phi(v_\infty) W 4\pi R^2 dR \simeq 1.2 \times 10^{34} \text{ protons/sec}$$

where N is the number of protons leaving the corona during 1 sec, Z_p is the number of close collisions between 2 protons whose potential energy exceeds $\frac{1}{2}kT$, $\Phi(v_\infty)$ is the fraction of protons whose collision velocity is sufficient for causing the escape, $2\pi W$ is the solid angle around the zenithal direction containing the escaping swift protons. Since the dissipation averages 6×10^{17} grams per year, it is 1 000 times less than the figure obtained by Keldysh and has no cosmogonic significance. It is demonstrated that the higher figure is 'wrong', and the upper limit of the dissipation is arrived at by using purely energetic considerations. Ryle's assumption of very hot portions of stellar corona is strongly criticized. It is suggested that the ratio of the potential (parabolic) energy of protons to their thermal energy is approx. identical for all stars, and that the distribution of the relative density in the corona is identical as well. A table of max. temperatures of the corona for various star classes is given, calculated on the basis of this constant ratio. The hypothesis of the "ultraviolet excess" in the stellar emission is criticized and the anomalies of excitation are explained by the emission from the corona.

F. LACHMANN

523.87

6977. On the absorbing properties of stellar atmospheres. D. CHALONGE and L. DIVAN. *C.R. Acad. Sci., Paris*, **230**, 720-2 (Feb. 20, 1950) In French.

The factor p relating colour temperatures and brightness temperatures of stars is deduced for spectral types O9-A5 and the sun for spectral regions above (p_1) and below (p_2) 3 700 Å. These should be > 1 or < 1 as the continuous absorption coeff. (K) decreases or increases with λ , and the observed changes (showing minima of ~ 0.3 at spectral type B8 - A6) are attributed to the increasing effects of H γ absorption after type A0. The high value of p_2 (2.00) for the sun implies a new absorption, for which K decreases with λ .

D. L. EDWARDS

523.87

6978. The vibrational stability of white dwarfs. P. J. LEDOUX and E. SAUVENIER-GOFFIN. *Astrophys. J.*, **111**, 611-24 (May, 1950).

The condition is established and studied in detail for the two main nuclear reactions which have been considered in connection with the generation of energy in these stars (carbon cycle and proton-proton reaction) when it takes place in the central region or in an external layer. It is shown that nuclear reactions

ould render the white dwarfs unstable except in a special case, and hence it seems that the generation of energy in these stars must definitely be attributed to some other cause.

A.

523.877

79. Hydrogen content and energy-productive mechanism of white dwarfs. T. D. LEE. *Astrophys. J.*, **1**, 625-40 (May, 1950).

The equilibrium states of white dwarf stars of arbitrary mass and chemical composition are discussed. An improved expression for electronic conductivity and free electron density in the intermediate degenerate state is derived. It is found that no appreciable amount of H can exist in any white dwarf star. The upper limit of H concentration (by weight) in the interior of a star having the mass of the sun is found to be 4×10^{-3} even in the absence of the carbon cycle. The corresponding value for stars of half the mass of the sun is 4.6×10^{-3} . Investigations on stability show that a white dwarf star cannot live on the nuclear energy produced in its interior. The alternate mechanism of energy produced in the envelope is discussed. The equilibrium distribution of H in the envelope is also calculated. From this the observed fact of strong H lines in the spectrum of white dwarfs is explained.

A.

523.877 : 539.153

80. Target areas for the collisional excitation of nebular lines. L. H. ALLER. *Astrophys. J.*, **111**, 9-10 (May, 1950).

The theoretical target areas for inelastic collisions involving metastable and ground levels associated

with the nebular lines appear to be in error. The densities of the O III ions responsible for the green nebular lines exceed values previously given by a factor of at least 3. Improved estimates of the abundance of O II and O III are given for a number of typical nebulae.

526.16

6981. Changes of deflections of the plumb-line brought about by a change of the reference-ellipsoid. F. A. VENING MEINESZ. *Bull. Geod. (No. 15)* 43-51 (1950).

Formulae are derived for given changes in size and shape of the reference-ellipsoid. Some applications to geodetic surveys are considered.

B. C. BROWNE

527

6982. Theory of blind navigation by dynamical measurements. J. J. GILVARRY, S. H. BROWNE AND I. K. WILLIAMS. *J. Appl. Phys.*, **21**, 753-61 (Aug., 1950).

The differential equation is considered which determines the position of a vehicle from dynamical measurements of the non-gravitational acceleration b made internally. Three linear approximations to the gravitational field $g(r)$ of the earth, which lead to explicit solutions of this equation, are considered and their limitations are discussed. An interval-wise solution (linear continuation) for trajectories of extended range is described, which is based on such linear approximations and has definite advantages in this application. The theory is applied to the trajectory of the German A10 vehicle.

A.

PHYSICS 53

53.081.5

83. A geometric treatment of "dimensions" in physics. P. MOON AND D. E. SPENCER. *Canad. J. Res. A*, **28**, 268-80 (May, 1950).

An idon or complete physical quantity is an entity with two attributes: quality and quantity. Formal rules are given for the manipulation of idons, and it is shown that they can be pictured as vectors in a 3-dimensional space. This geometrization is not necessary, of course, but it often gives added grasp of the subject; just as vector analysis is never necessary in physics, though it is often convenient. There are 6 practical applications of the theory, all of which are handled in a precise and dependable way by the geometric method.

A.

53.081.5 : 536.5.081

84. Remarks on the role of temperature in dimensional analysis. G. SABATIER. *Rev. Sci., Paris*, **87**, 57-73 (April-June, 1949) In French.

Shows that the problem of what dimensions to attribute to temperature is capable of a unique solution. The general theory outlined is applied to several particular cases, including the determination of the temperature, as a function of the time and the surface temperature, at a point inside a solid of given shape, thermal capacity and thermal conductivity, the surface temperature of which is raised by a definite amount; the loss of heat from a body in a streaming

fluid, and the distribution of energy in the blackbody spectrum.

S. WEINTROUB

FUNDAMENTALS 530.1

530.1 : 550.38

6985. Magnetism and the rotation of celestial bodies. A. E. BENFIELD. Letter in *Nature, Lond.*, **166**, 31 (July 1, 1950).

An estimate based on Fermi-Dirac statistics is made of the charge separation at high temperatures and pressures for an earth with a conducting core. This is found to be very much smaller than that required for terrestrial magnetism by Berlage's theory [Abstr. 3738 (1950)].

R. A. NEWING

530.12 : 531.51

6986. The Doppler effect in the field of a thick spherical shell. V. V. NARLIKAR AND A. PRASAD. *Proc. Indian Acad. Sci. A*, **30**, 181-3 (Oct., 1949).

The relativistic field of a thick spherical shell of matter is worthy of notice inasmuch as it provides the only known example of a Euclidean pocket in a Riemannian space-time. The boundary conditions are used to obtain correct expressions for the metric in different parts of the field and an inaccuracy of

Cambridge's treatment is removed. The constant of the Doppler effect which is a violet-shift, follows from the boundary conditions in an unforced manner.

A.

530.12 : 539.152

6987. Masses and energies of atomic nuclei. A. M. MOSHARRAFA. *Proc. Math. Phys. Soc. Egypt*, **4**, 15–22 (May, 1949).

In a previous paper [Abstr. 520 (1947)] a metric of space-time was proposed by the author and a similar metric has been independently proposed by G. Randers. Both forms lead to the world line of a charged particle as a geodesic. The author now points out that the new metric makes the mass of a particle a function of its potential energy. This gives a simple explanation of the mass deficiency of nuclei, known as the "packing" effect. The potentials and effective radii of atomic nuclei are calculated from available data. The results agree with those obtained by Gamow in the theory of α -emitters. The mass of an electron in a nuclear field indicates that β disintegration is more akin to the emission of field energy than to particle ejection. The mass of a positron becomes very small in the neighbourhood of nuclei. A purely empirical graph is given of $(M - A)$ plotted against A , where M is the atomic weight and A the mass number of an element. It appears to exhibit periodic properties. A period of 4 can be seen, also possibly a period of 16 or 18.

A.

530.14

6988. Killing's equations and the fundamental metric tensor. K. V. NIKOLSKIĬ. *Dokl. Akad. Nauk, SSSR*, **72** (No. 2) 277–9 (1950) *In Russian*.

For spinors and tensors of various orders relations are deduced which correspond to Killing's equations. If the fundamental metric tensor g is expressed in terms of the 3rd-order tensor c by the relations $g_{\alpha\beta} = c_{\alpha\mu}^{\lambda} c_{\beta\lambda}^{\mu}$, $c_{\alpha\beta}^{\lambda} = -c_{\beta\alpha}^{\lambda}$, then for its components a system of differential equations is also established. In this way a uniform field theory can be built up using the 3rd-order antisymmetric tensor as the fundamental metric one.

J. JACOBS

530.145

6989. A new formulation of the mathematics of quantum theory. O. M. NIKODYM. *Ann. Inst. Poincaré*, **11** (No. 2) 49–112 (1949) *In French*.

The theory of Hilbert space is developed by regarding linear manifolds as elements of a Boolean algebra. The geometrical decomposition replaces the notion of the Resolution of the Identity. The spectral properties of linear operators are given a geometrical interpretation. The continuous spectra of operators in quantum mechanics are discussed.

J. R. MADDOX

530.145

6990. On the spur calculations in quantum mechanics. K. NISHIJIMA. Letter in *Progr. Theor. Phys.*, **5**, 155–7 (Jan.–Feb., 1950).

530.145

6991. Circular and elliptical quantum orbits. M. F. SOONAWALA. *Indian J. Phys.*, **24**, 95–102 (March, 1950).

Some further implications of the gravitational inverse cube law of attraction between two particles,

deduced in a previous paper from a generalization of the quantum laws, are discussed. The treatment extended to elliptical orbits and expressions derived for the force of attraction between the particles, the energy of one of the particles, and the conditions for the change in the quantum numbers.

530.14

6992. The quantum mechanics of localizable dynamical systems. T. S. CHANG. *Phys. Rev.*, **78**, 592–3 (June 1, 1950).

Expressions for the operators in Dirac's general theory are explicitly constructed and their commutation laws directly worked out. Conditions for the expectation values of dynamical variables or their densities to be independent of the parametrization of the surface are given and it is shown that of the two conjugate field variables in Weiss' theory, one is a parametrization-independent variable and the other is a parametrization-independent density. It is shown that P^n in Dirac's theory does not have any simple expression other than that given in Weiss' theory.

530.145

6993. Contribution to the theory of non-localizable fields. B. KWAL. *J. Phys. Radium*, **11**, 213–18 (May, 1950) *In French*.

A new formulation of the proper reciprocal equations for a spin or field follows a discussion of the classical analogue of Yukawa's theory [cf. Abstr. 48 (1950)].

G. J. KYNCE

530.145

6994. Second quantization. P. A. M. DIRAC. *Ann. Inst. Poincaré*, **11** (No. 1) 15–47 (1949) *In French*.

A review of procedures used for first- and second-order (Klein-Gordon) equations. The Pauli-Weisskopf method is applied to the radiation field, and the effect of supplementary conditions discussed.

J. R. MADDOX

530.145

6995. The shift of the $2S_{\frac{1}{2}}$ level of hydrogen. G. MORPURGO. *Nuovo Cim.*, **7** (No. 3-bis) 313–222 (May, 1950) *In Italian*.

The question is considered if the electromagnetic shift of the $2S_{\frac{1}{2}}$ level of H has some classical corresponding effect in the sense of the Bohr correspondence principle; or if, on the contrary, it is an effect necessarily associated with the quantization of the radiation field and atomic system. By use of the old Born-Brody perturbation theory (introducing action and phase variables) it is shown how, at least in the second e -approximation, the effect is a consequence of the quantization. This conclusion is in agreement with Welton's ideas.

A.

530.145

6996. Field and charge measurements in quantum electrodynamics. N. BOHR AND L. ROSENFELD. *Phys. Rev.*, **78**, 794–8 (June 15, 1950).

A survey is given of the problem of measurability in quantum electrodynamics and it is shown that it is possible in principle, by the use of idealized measuring arrangements, to achieve full conformity with the interpretation of the formalism as regards the determination of field and charge quantities.

A.

530.145 : 535.14
 Theory of longitudinal photons in quantum hydrodynamics. S. N. GUPTA. *Proc. Phys. Soc., B*, **63**, 681-91 (July, 1950).

The radiation field is quantized by introducing 4 types of photons—2 transverse, 1 longitudinal and 1 scalar. The scalar photons are treated by using an indefinite metric, and it is found necessary to modify the usual supplementary condition slightly. The present theory offers a justification for the symmetrical treatment of the 4 components of the electromagnetic potential, recently applied by a number of authors, and proves to be very convenient for applications. The results of physical interest, however, are the same as obtained from the ordinary quantization. A.

530.145
 8. Multipole radiation as an Eigenwertproblem. FRANZ. *Z. Phys.*, **127** (No. 4) 363-70 (1950) In German.

It is shown that operators for the orbit and spin angular momenta (the sum satisfying a conservation law) may be specified for the photon by means of Maxwell's theory, just as the operators for the electron may be specified by means of Dirac's theory. The equations for which the magnitude, and one component, of the total angular momentum, have special values, are the well known solutions for the electric and magnetic multipole radiations. P. M. DAVIDSON

530.145 : 538.3 : 535.14
 9. Radiation reaction in collision processes. (2). First radiative correction for an arbitrary process including electrons, positrons and light quanta. Z. BA AND G. TAKEDA. *Progr. Theor. Phys.*, **4**, 1-41 (April-June, 1949).

Detailed calculation, using the Tomonaga subtraction technique, of higher-order radiative corrections, which supports an earlier contention that renormalization can eliminate all divergences in electromagnetic scattering phenomena.

J. R. MADDOX

530.145 : 538.3 : 535.14
 10. Radiative electron interaction. II. H. J. ROENEWOLD. *Proc. K. Ned. Akad. Wet.*, **53** (No. 5) 1-24 (1950).

Application of an earlier development of a theory of radiation to higher-order transitions. Discussion of radiation processes in a Hohlraum and the conclusion that the results are equivalent to those of Feynman in his "dualistic" formulation.

J. R. MADDOX

530.145 : 539.163
 01. On the theory of spontaneous and "forced" K-capture. M. GÜNTHER. *Acta Phys. Polon.*, **10** (No. 1-2) 7-28 (1950).

The purpose of this paper is to calculate the probability of electron K-capture on the basis of the theory of interaction of nucleons with electron-neutrino fields, in such a way as to avoid as far as possible all special assumptions regarding the magnitude of the nucleon radius and the behaviour of the electron wave-function inside it. The final formulas contain only the range of the nuclear forces, i.e. the meson mass. The dependence of the probability of a

K-capture process on the atomic number Z of the element is also established, and is thus transformed into another one with the atomic number $Z-1$. Finally, some consequences regarding the hypothetical "forced" K-capture probability when irradiating a suitable material by antineutrinos are drawn—this being a consequence of the neutrino-hole theory. A.

530.145
 7002. On the interactions of mesons of spin zero. G. PETIAU. *C.R. Acad. Sci., Paris*, **230**, 1038-9 (March 13, 1950) In French.

Starting with the matrix equations of the meson, all possible types of interaction and the resulting equations are examined. Two types of interaction with a vector field, two with a scalar field and one with a symmetrical tensor field are possible and are included. G. J. KYNCH

530.145 : 530.12
 7003. On the interaction of mesons with the gravitational field. I. R. UTIYAMA. *Progr. Theor. Phys.*, **2**, 38-62 (March-June, 1947).

The interaction is considered in a manner which could be extended to spinor or other tensor fields. The system considered is that of a neutral vector meson field interacting with a weak gravitational field, and the results are confined to the assumption of weak interaction. The equations for photons interacting with gravitons are obtained by allowing the meson mass to tend to zero. This a classical theory. G. J. KYNCH

530.145 : 530.12
 7004. On the interaction of mesons with the gravitational field. II. R. UTIYAMA. *Progr. Theor. Phys.*, **3**, 14-25 (Jan.-March, 1948).

The field equations considered in the preceding Abstr. are written in canonical form and quantized. It is believed that the theory with interaction can be obtained as far as powers of the interaction constant higher than the second can be neglected.

G. J. KYNCH

530.145 : 538.3
 7005. Notes on the two body problem of electrodynamics. P. HAVAS. *Acta Phys. Austriaca*, **3** (No. 4) 342-51 (1950) In German.

It is shown by means of an example that dissimilar charges in an electric field can have motions in which the field due to each never reaches the other. Thus neither charge affects the motion of the other. It is also shown that the treatment of pair production and annihilation by methods which seek to reduce the process to a single body problem cannot avoid the characteristic difficulties of the electrodynamic many-body problem. P. M. DAVIDSON

530.145
 7006. On an approximate solution of the many-body problem of Fermi-Dirac particles. M. NOGAMI. *Progr. Theor. Phys.*, **5**, 65-71 (Jan.-Feb., 1950).

The q -number theory of this problem, the assumption of a very large number of particles, makes it possible to neglect, in certain circumstances, a large group of interaction terms. The resulting Schrödinger equation in configuration-space can be solved exactly, the solution being similar in form to a 2nd-order perturbation expression. The distribution of

particles is markedly different from that in the zero-order approx. usually used. The results are applied to heavy nuclei. G. J. KYNCH

530.145

7007. Note on the self-energy and self-stress. K. SAWADA. *Progr. Theor. Phys.*, **5**, 117-32 (Jan.-Feb., 1950).

Is the Pauli regularization technique able to eliminate both self-energy and self-stress for a relativistic particle in interaction with a field? Many different situations are discussed. Only electrons and photons are found to be amenable to the process.

J. R. MADDOX

530.145

7008. Masses of fundamental particles. G. STEPHENSON. Letter in *Nature, Lond.*, **165**, 1018 (June 24, 1950).

An empirical numerical relation has been found which relates to the electron mass either the masses of the proton and the neutron, or the masses of the μ - and the π -meson.

530.145

7009. Fundamental lengths and masses of fundamental particles. H. T. FLINT. Letter in *Nature, Lond.*, **166**, 30 (July 1, 1950).

Equating two expressions for the range of nuclear forces, $L/M_0c = ke^2/m_0c^2$ (M_0 = proton mass, m_0 = electron mass) gives 0.4688 as the magnitude of the constant k , in close agreement with Fürth's deduction of 15/32 [*Phys. Z.*, **30**, 895 (1929)].

530.145

7010. What is an elementary particle? E. SCHRÖDINGER. *Endeavour*, **9**, 109-16 (July, 1950).

A critical review of modern ideas on the characteristics of waves and particles considered as two different aspects of the same phenomenon. The uncertainty principle is examined, according to which the co-ordinates and their first time-derivatives of a particle cannot be precisely known at the same instant, which leads to the loss of the particle's individuality. The formulation of the wave equation is mentioned. Bose-Einstein and Fermi-Dirac statistics are explained and illustrated by examples drawn from everyday experience and their application to electrons and photons is discussed. The condition for predominance of the particle aspect of a phenomenon is also studied.

530.145 : 539.152.1

7011. On the electromagnetic properties of nucleons. M. TAKETANI, S. MACHIDA AND T. TAMURA. Letter in *Progr. Theor. Phys.*, **5**, 150-2 (Jan.-Feb., 1950).

530.145

7012. Remark on a note of R. P. Feynman. A. VISCONTI. *C.R. Acad. Sci., Paris*, **230**, 928-9 (March 6, 1950) *In French*.

The note referred to [see Abstr. 243 (1950)] discusses the theory of the positron. A certain mathematical point is criticized and it is pointed out that what is really involved is a Dirichlet problem for the system of linear equations with first-order derivatives, represented by a Dirac equation. This is briefly discussed.

L. S. GODDARD

7013. On mixtures of meson fields. C. MA. *C.R. Acad. Sci., Paris*, **230**, 1508-10 (April 24, 1950) *In French*.

No mixture of meson fields of mass $286 m$ can explain the asymmetry of n - p scattering at 90°. Terms due to the slight difference in mass of n and p do not influence this conclusion. G. J. KYNCH

530.1

7014. On the decay of heavy mesons. II. Case of the symmetrical interaction. S. SASAKI, S. ONN AND S. OSAKI. *Progr. Theor. Phys.*, **5**, 25-41 (Jan.-Feb., 1950).

Extensive calculations of the decay of τ -mesons into π - and neutral mesons, and the subsequent decay of these have been made using the Tomonaga-Schwinger formalism, for all types of mesons with neutral and symmetrical interactions and different types of couplings. A list of forbidden processes is given. Different times are obtained with different regulator procedures but all are rather short $\sim 10^{-12}$ sec or much smaller. For the decay $\tau \rightarrow \rho + \pi$, however, the times are of order 10^{-11} s. The equivalence theorems of Dyson for pseudoscalar interactions are questioned, for such processes. See Abstr. 5517 (1950). G. J. KYNCH

530.1

7015. The construction of a relativistically invariant η or S -matrix for many particles. K. WILDERMUTH. *Z. Phys.*, **127** (No. 5) 551-62 (1950) *In German*.

Formulae for the S -matrix in many-particle problems, obtained earlier [Abstr. 6260-1 (1950)] have been translated into formulae for the phase matrix, which can be put into relativistic form.

G. J. KYNCH

530.1

7016. A quantum theory for nuclear forces. M. ELNADI. *Proc. Math. Phys. Soc. Egypt*, **4**, 35-47 (May, 1949).

Assuming de Broglie's theory for particles of spin $\frac{1}{2}$, a modified set of wave equations was developed for the description of such particles (mesons and photons). It was shown that 2 expressions could be derived for the probability density-current vector and the energy-momentum tensor. Both expressions for the probability density have +ve and -ve values related to particles with +ve and -ve energies respectively.

530.14

7017. On the nuclear forces. H. ENATSU. *Progr. Theor. Phys.*, **5**, 102-16 (Jan.-Feb., 1950).

Generalizing the Lagrangian of the interaction has been done by Schoenberg, and assuming the relations between coupling constants in the symmetrical and charged spin 0 meson fields, nuclear forces which have the same character as the Bethe potential by the neutral vector meson theory are given. There is, however, no difference between the usual scalar-pseudoscalar mixed theory and this generalized interaction in the approximation adopted here.

530.145 : 539.172

7018. A variational method for non-conservative collisions. M. LAX. Letter in *Phys. Rev.*, **78**, 306-7 (May 1, 1950).

530.145 : 537.534.74

Proton-proton scattering in charged scalary. K. A. BRUECKNER AND K. M. WATSON.
in *Phys. Rev.*, 78, 495-6 (May 15, 1950).

4th-order calculation has been made, including relativistic terms of order v^2/c^2 . These terms are usually small, but tend to reduce the asymmetry of p - p scattering about 90° and reduce the backward scattering. The latter is less strongly marked for p - p than for n - p scattering. If these terms were made zero, higher orders would become important.

G. J. KYNCH

530.145 : 537.534.74

The interpretation of low energy proton-proton scattering. J. D. JACKSON AND J. M. BLATT.
Mod. Phys., 22, 77-118 (Jan., 1950).

By "low energy" is meant not greater than 15 MeV. A formula for the differential cross-section when only s -waves are effective is taken as a basis for the analysis of experimental results. Particular attention is drawn to the destructive interference between Coulomb repulsion and nuclear attraction near 0.5 MeV bombarding energy, especially for scattering through $\sim 90^\circ$ (centre of mass). A formula for obtaining the s -wave phase shift from experimental data is given, and numerical values of quantities useful in the analysis are tabulated as functions of scattering angle and energy. A more approximate analysis, with graphs and tables, is given for contributions due to p - and d -waves. The practical possibilities of detecting p - d -phase-shifts, and of distinguishing between p - and d -waves, are discussed. A survey of all experimental data is then made, covering the range 0.177 to 15 MeV proton energy. There is almost no sign of influence by factors depending on the specific shape of the interaction potential, and the best fit to the data, if one ignores such effects altogether, yields the parameters $a = (-7.67 \pm 0.05) \times 10^{-13}$ cm, $r_0 = (2.65 \pm 0.07) \times 10^{-13}$ cm, where r_0 is the effective range of the forces and " a " is a scattering length at zero energy [cf. Abstr. 2250 (1947) for the analogous n - p case]. An estimate of the size of the shape-dependent factor is made, but new precise measurements of the differential cross-section at 90° in the energy region 420-450 keV are strongly advocated as being sensitive to the shape-factor. An energy definition of 0.1% and a determination of cross-section to $\pm 1\%$ would be required for the results to be of value. By assuming definite well shapes, parameters for the 4 conventional types (square, Gaussian, exponential and Yukawa) are obtained from the experimental data. The fit to the Yukawa potential corresponds to a meson mass of $(32 \pm 8)m_e$. To distinguish between the extremes of the square well and the Yukawa potential would require a cross-section measurement of 1% accuracy at 10 MeV, assuming that the energy itself could be defined to $\pm 1\%$. Other suggested experiments are (a) a repetition of the cyclotron measurements at 10 MeV [Abstr. 2901 (1948)] as these seem out of line with other data; (b) careful determination of the relative differential cross-section as a function of angle near 90° for energies 5-10 MeV, to establish the presence or absence of p - and d -wave contributions; (c) if (b) gives a positive result, to measure

absolute cross-sections over a wide angular range at well-defined energies (Van de Graaff machines) to distinguish between p - and d -wave effects.

A. P. FRENCH

530.145.6

7021. The structure of linear relativistic wave equations. I. K. J. LE COUTEUR. *Proc. Roy. Soc. A*, 202, 284-300 (July 7, 1950).

The structure of linear relativistic wave equations of the form $(i\alpha_\mu \partial^\mu - \chi)\psi = 0$ is discussed. In general, such equations describe particles with a spectrum of mass and spin values. It is proved that the physical requirement that all particle states can be unambiguously specified by the momentum, mass, spin and charge, leads to a complete determination of the eigenvalues of the total spin. These must form an arithmetical progression $S_H, S_H - 1, S_H - 2, \dots$, terminating at 0, $\frac{1}{2}$ or 1. A coupling diagram is associated with every wave equation and necessary restrictions on the shape of the diagram are worked out. There results a useful reduction in the number of mathematical possibilities.

A.

530.145.6

7022. The structure of linear relativistic wave equations. II. Representations. K. J. LE COUTEUR. *Proc. Roy. Soc. A*, 202, 394-407 (Aug. 7, 1950).

A representation of the spin matrices $I_{\mu\nu}$ and of the matrices α_μ , associated with the wave equations of part I [Abstr. 7021 (1950)], is constructed. In this representation s , the total spin, is diagonal, which simplifies the calculation of the simultaneous mass and spin eigenvalues. Examples of mass-spin spectra are given, and it is proved that in certain, easily recognized, cases the mass eigenvalues are not all independent. The matrix elements of the magnetic moment are calculated, and an example is given of a particle with an intrinsic magnetic moment equal to that of the proton.

A.

530.145.6

7023. Variational principles for reflection coefficients of potential barriers. G. TORALDO DI FRANCA. *Nuovo Cim.*, 7, 255-65 (May, 1950) *In Italian*.

Several variational principles have been derived in recent years by Hulthén, Tamm, Schwinger and others for dealing with scattering problems. This paper is concerned with the application of 3 similar principles to the computation of the reflection coefficient of a potential barrier for an incident plane wave of arbitrary direction. These principles are represented respectively by equations giving a value of the reflection coefficient r , which is stationary for small variations of the wave function u about its true value. Some simple examples of application are given by using the WKB approximation. The first 2 terms of a series expansion are given for a thin barrier, in the acoustical case.

A.

530.145.6 : 538.566

7024. Propagation of a cut-off train of de Broglie waves. A. RUBINOWICZ. *Acta Phys. Polon.*, 10 (No. 1-2) 79-86 (1950).

Formulae have been developed describing com-

pletely the arrival of the wave front, the forerunner, and the main wave. A.

530.145.6

7025. On the interactions in a Fermi gas. Polarization phenomena, correlation energy, electron condensation. W. MACKE. *Z. Naturforsch.*, 5a, 192–208 (April, 1950) In German.

The properties of electrons moving in a region of constant positive charge density are investigated wave-mechanically. An estimate is made of the correlation energy between the electrons by using a perturbation method, in which the Coulomb interaction between the electrons is the perturbing term, and summing all correction terms for the energy of the electron gas. The expression is similar to the result one obtains on determining the energy by a variational method and using screened Coulomb potentials $er_{ij}^{-1} \exp(-\lambda r_{ij})$ as the perturbing term. This result is interpreted as establishing an analogy between the correlation energy in an electron gas and the polarization energy in Debye's theory of electrolytes. In both cases it is supposed that a screening of the repulsive forces is effected due to the polarization by the current carriers of their surroundings. This result is discussed in relation to the phenomenon of electron condensation at the surface of the Fermi sphere as suggested in Heisenberg's theory of superconductivity [Abstr. 3203 (1947)]. It is concluded that Heisenberg's assumptions are justified, i.e. that the electrons at the surface of the Fermi sphere have exceptional properties, and that their mutual interactions establish a long-range order between them. P. T. LANDSBERG

530.162 : 531.19 : 533.7

7026. On the fluctuation of energy of gases in the Bose-Fermi quantum statistics. K. SZÉLL. *J. Chem. Phys.*, 18, 636–8 (May, 1950).

The energy fluctuation of monatomic gases is calculated in the Bose-Fermi quantum statistics computing the mean values by the Bose and Fermi distribution functions and on the base of the entropy equation. The results obtained are compared with FÜRTH's calculations. A.

530.162 : 539.132

7027. On the fluctuation of rotational energy of polyatomic gases in the Bose-Einstein and Fermi-Dirac statistics. K. SZÉLL. *Hungar. Acta Phys.*, 1 (No. 6) 22–6 (1950).

An equation for the mean square of the rotational energy fluctuation of polyatomic gases obeying the Bose-Einstein or Fermi-Dirac statistics is derived, at slight degeneration, in two ways, firstly by using the Bose-Einstein or Fermi-Dirac distribution function, respectively, and secondly on the basis of the entropy equation. T. C. TOYE

530.162 : 535.12 : 536.7

7028. On the thermodynamics of matter waves. F. KAEMPFER. *Z. Phys.*, 125 (No. 7–10) 487–96 (1949) In German.

Some analogies between black-body radiation and the properties of a Bose-Einstein gas below its condensation temperature T_0 are pointed out, e.g. the

energy density (u) is a function of temperature only. This suggests that it may be possible to describe the thermodynamic behaviour of such a gas by means of a classical wave theory. This is attempted: the laws corresponding to those of Stefan, Wien and Planck in radiation theory are derived. With the usual notation they take the form $u = \sigma T^4$, $u_\nu = \nu^{3/2} f(\nu/T)$, $f(\nu/T) = \pi(2m)^{3/2} h^{-1} [\exp(h\nu/kT) - 1]^{-1}$. P. T. LANDSBERG

530.162 : 530.145.6 : 536.7

7029. The second law of thermodynamics deduced from the quantum theory. M. BORN. *Ann. Inst. Poincaré*, 11 (No. 1) 1–13 (1949) In French.

See Abstr. 4720 (1950).

530.162

7030. Thermodynamics of an oscillator assembly. R. P. SINGH. *Indian J. Phys.*, 24, 155–62 (April, 1950).

The thermodynamics of an assembly of linear harmonic oscillators is worked out. The expressions for specific heat obtained here for Bose and Fermi statistics are compared with those of Auluck and Kothari. Their results, obtained by use of partition theory of numbers, show that entropy and hence, specific heat is the same for both B.E. and F.D. cases while here it is approximately the same, and is exactly. In the derivation here the sums have been replaced by integrals and it remains to investigate where the difference actually lies in the two cases. P. T. LANDSBERG

530.162

7031. Some recent results on the Brownian movement. R. FORTET. *Ann. Inst. Poincaré*, 11 (No. 1) 175–223 (1949) In French.

The term "Brownian movement" is here used in a wider sense (which is explained) than is customary in physics. A deep statistical analysis of this "movement" is made. This depends on the theory of random variables and functions. The Einstein-Smoluchowski method and the more recent methods of Ornstein, Uhlenbeck and Wang are examined separately and used to solve various problems concerning the projection of the motion on to the x -axis, or on to the xy -plane. The distribution functions for certain random variables of physical significance are found. The method of Ornstein and Uhlenbeck is critically examined, and the alternative method of Doob for treating the Langevin equation is discussed. L. S. GODDARD

530.162

7032. Determination of the spectrum of the flow of Brownian motion. S. KAKUTANI. *Proc. Nat. Acad. Sci., Wash.*, 36, 319–23 (May, 1950).

A Brownian motion is defined in an abstract mathematical manner, and the flow of this motion is analysed. Polynomial chaos and the spectral decomposition of the flow are studied. Homogeneous chaos is also considered. L. S. GODDARD

530.162 : 536.7

Thermodynamics and the canonical distribution. See Abstr. 7218

530.162 : 548.8

Crystal statistics of a two-dimensional Ising lattice. See Abstr. 6825, 7598

GENERAL MECHANICS MECHANICS OF SOLIDS 531

531.132.1

3. An elementary kinematical property analogous to Fermat's principle. L. SOBRERO. *Atti Accad. Lincei (R.C. Cl. Sci. Fis. Mat. Nat.)* 8, 360-4 (April, 1950) *In Italian*.

Corresponding to a point P of a lamina moving in its own plane there is a "conjugate" point P' fixed in space, such that the length of the "kinematical path" joining P and P' to the instantaneous centre of rotation is stationary for small displacements of the lamina.

R. A. NEWING

531.259.2

34. Derivation of the equations of equilibrium of an elastic shell from the general theory of elasticity. Z. CHIEN. *Sci. Rep. Nat. Tsing Hua Univ.*, 5, 10-51 (Oct., 1948).

The macroscopic equations of equilibrium of an elastic shell are derived from the general 3-dimensional microscopic theory of elasticity. The process involves only the integration of the 3-dimensional equations of equilibrium across the thickness of the shell. A.

MECHANICAL MEASUREMENTS 531.7

531.7 : 621.317.39

35. Some electrical methods of measuring mechanical quantities. F. J. WOODCOCK. *Proc. Inst. Elect. Engrs, Pt I*, 97, 136-55 (July, 1950).

For abstract see Abstr. 3798 (1950).

531.711 : 535.417

36. Interference methods for producing and calibrating end standards. C. G. PETERS AND W. B. JERMON. *J. Res. Nat. Bur. Stand., Wash.*, 44, 19-42 (April, 1950).

A interferometric apparatus developed at the National Bureau of Standards for ruling meter scales in terms of wavelengths of light requires accurate determination of the length of a decimeter etalon. To compare the results of the interferometric methods of measurement used at this Bureau with those of other national laboratories, etalons of fused quartz having highly polished plane and parallel end surfaces were made and calibrated at the Bureau. They were then sent to the Bureau International des Poids et Mesures, Physikalisch-Technische Reichsanstalt and the National Physical Laboratory for calibration. Diverse interferential methods used by the different laboratories give the same lengths to an average deviation of 0.016μ and to a probable uncertainty much less. Besides furnishing a direct comparison of the results obtained by different interferential methods, the investigation gives values for the index of refraction of air and also wavelength values for several radiations of krypton and cadmium. These are included in the paper. Because of inherent advantages of fused quartz etalons as separators for Fabry-Perot interferometers, the methods used in

making and calibrating these etalons are given in detail.

A.

531.715

7037. A mechanical arrangement for measuring small changes in length. G. LEIBFRIED. *Z. Phys.*, 127 (No. 5) 580-7 (1950) *In German*.

An apparatus for measuring length changes such as are observed when plastic deformation begins in a single crystal is described. The linear movement is taken up by 2 fine wires rolling between plane surfaces, and the angular movement of the wires is recorded optically. A magnification of 3×10^5 is achieved, and an accuracy of about $10 \text{ \AA}$ is claimed. Some results for single Al crystals are discussed.

J. G. OLDROYD

531.717.1 : 537.531 : 620.179.1

7038. An X-ray method for determining tin coating thickness on steel. H. F. BEEGLY. *J. Electrochem. Soc.*, 97, 152-7 (April, 1950).

The thickness of tin coatings on steel can be measured rapidly and non-destructively on either side of the sheet by application of a simple X-ray technique. The method is based on the selection of an X-ray beam of a wavelength that excites significant amounts of secondary radiation in the base metal but not in the coating. With this method, the results were comparable in accuracy and reproducibility with those obtained with the usual chemical methods for measuring the coating thickness of tin on steel. The investigation placed emphasis on use of a commercial X-ray spectrometer for measurement of tin coating thickness on a laboratory scale, but enough work was done to show that the principle used for measuring tin coating weights on steel is applicable to other coatings and to the continuous indication and control of tin coating weights on the electro-tinning line. Such a unit has been designed and built.

A.

531.717.1 : 539.165 : 620.179.1

7039. Noncontacting thickness gauge using beta rays. C. W. CLAPP AND S. BERNSTEIN. *Elect. Engng, N.Y.*, 69, 308-10 (April, 1950).

The general principles are given, using Sr^{90} as source and an ionization chamber as detector, with a window of Al 0.001 in thick. The source has a $\frac{1}{2}$ -life of 25 years and there is no γ -emission, thus requiring minimum shielding for protective purposes. A motor-driven chopper is used in the beam to produce a 90 c/s current which can be amplified by a simple a.c. amplifier. A second source of 90 c/s is used as a reference comparison and the resultant converted to d.c. by a metal rectifier circuit. Application is to various metallic and non-metallic materials, which may be moving. Block diagrams and illustrations are given.

E. H. W. BANNER (R)

531.724

7040. Remarks on Mizushima's method for the determination of surface area of powders. YING FU. Letter in *J. Chem. Phys.*, 18, 899-900 (June, 1950).

531.724

7041. Estimation of the surface areas of powders from the temperature dependence of adsorption from solution. W. HIRST AND J. K. LANCASTER. Letter in *Research, Lond.*, 3, 336-7 (July, 1950).

531.752

7042. Tungsten helical spring balance. S. L. MADORSKY. Note in *Rev. Sci. Instrum.*, **21**, 393-4 (April, 1950).

531.761 : 621.317.39

7043. The measurement of short time intervals by means of d.c. measuring devices. W. ENDERS. *Öst Z. Telegr.-Teleph.-Funk-Fernsehtechn.* [ÖTF] **4**, 12-19 (Jan.-Feb., 1950) In German.

It is shown that short time intervals, such as the closing time of a switch, can be determined by measuring the voltage to which a condenser, in series with the device to be examined, is charged through an ohmic resistance. The necessary formulae are derived and the effects of various sources of possible error are examined in great detail. High accuracy of measurement is claimed to be attainable within a range of about 5 m sec to 10 sec.

R. H. GOLDE (R)

531.781 : 621.317.39 : 620.172.222

7044. An unbonded strain gauge. S. BAXTER AND H. A. VODDEN. *J. Sci. Instrum.*, **27**, 187-8 (July, 1950).

Construction details are given. The calibration curve of a typical gauge is shown and a nomogram for ease of gauge design given.

531.787

7045. Theory of the piston manometer. A. M. PIRVERDYAN; Reply to above: M. K. ZHOKOVSKIĬ. *J. Tech. Phys., USSR*, **20**, 368-9 (March, 1950) In Russian.

531.791

7046. An apparatus for counting small particles in random distribution, with special reference to red blood-corpuscles. H. S. WOLFF. Letter in *Nature, Lond.*, **165**, 967 (June 17, 1950).

MECHANICS OF FLUIDS 532

532.122

7047. On the compressibility of electrolytic solutions. G. BRANCA AND A. CARRELLI. *Nuovo Cim.*, **7**, 190-5 (May, 1950) In Italian.

Compressibility of electrolytic solutions is found from determination of ultrasound velocity by measurement of the diffraction spectra. Law of variation (assuming Debye-Hückel theory) has been given by Bachem [*Z. Phys.*, **101** (No. 9-10) 541-77 (1936)] and it is found that the electrolytes which give anomalous results for conductivity also give anomalous results for compressibility variation.

T. S. E. THOMAS

532.123

7048. Limiting negative pressure of water. L. J. BRIGGS. Letter in *J. Appl. Phys.*, **21**, 721-2 (July, 1950).

532.133

7049. Non-Newtonian surface viscosity. Change of phase produced by a velocity gradient. M. JOLY. *J. Phys. Radium*, **11**, 171-8 (April, 1950) In French.

Eyring's theory of viscosity is modified by introducing a relaxation time corresponding to changes of

molecular state which can only occur discontinuously. It is deduced that, under laminar flow conditions of a surface layer, the viscosity increases with time and a change of physical state can be produced.

J. E. CAFFRY

532.137

7050. Scheme for analyzing capillary measurements on non-Newtonian liquids. O. H. CLARK AND M. L. DEUTSCH. *J. Appl. Phys.*, **21**, 713-15 (July, 1950).

The inability to assign to a flow measurement any particular shear rate, or even a known range of shear rates, is overcome by developing simple relations connecting the directly measured quantities, pressure and flow rate, with viscosity and shear rate. Application to Bingham bodies is easy and an illustration is given. There are certain allied measuring difficulties in application to measurement at high rates of shear which are discussed briefly. A simple approximate formula applicable to cases of moderate deviation from Newtonian behaviour is given.

532.51

7051. An approximate solution for incompressible flow about an ellipsoid near a plane wall. P. EISENBERG. *J. Appl. Mech.*, **17**, 154-8 (June, 1950).

Using the method of successive images, an approximate solution for the velocity potential is obtained in closed form for incompressible flow about an ovary ellipsoid near a plane wall. The velocity distribution is computed from this solution in two ways. The first computation properly predicts differences in velocities on opposite half-meridians of the ellipsoid. A second method results in a symmetric velocity distribution but is useful for rapid estimates of the average wall effect. Pressure distributions calculated by this theory are compared with values measured on 4 : 1 and 6 : 1 ellipsoid models.

532.54 : 536.2

7052. Potential flow into circumferential openings in drain tubes. D. KIRKHAM. *J. Appl. Phys.*, **21**, 655-60 (July, 1950).

A theoretical analysis of the effect of the spaces between drain tube units as used in the artificial drainage of soil is given. The problem is one of potential flow; therefore, the results are applicable to heat flow, etc. The basic problem solved is that for axially symmetric flow from an external cylindrical boundary at constant potential to a series of equal, equally spaced openings at a lower potential on the otherwise impervious drain tube. Approximate solutions are derived and are utilized for tabulation of numerical results.

532.582.3

7053. The translation of two bodies under the free surface of a heavy fluid. A. COOMBS. *Proc. Camb. Phil. Soc.*, **46** (Pt 3) 453-68 (1950).

General expressions are found for the wave resistance and lift of a cylinder of arbitrary cross-section, in a uniform horizontal stream of heavy perfect fluid, when a second cylinder of arbitrary section is present. Numerical evaluations for two circular cylinders are discussed, when the cylinders are at the same depth below the free surface of the fluid and when their axes are in the same vertical plane.

J. G. OLDROYD

54. Experimental study of waves. New method of generation. J. LARRAS AND J. LAURENT. *C.R. Acad. Sci., Paris*, **230**, 1504-6 (April 24, 1950) In French.
- Preliminary description of a water tank for the study of the breaking of waves, etc., specially designed to avoid reflections. J. E. CAFFYN

CAPILLARITY 532.6

- 532.6 : 541.182
555. The lateral diffusion of a cloud of falling droplets. D. R. DAVIES. *Proc. Camb. Phil. Soc.*, **46** (Pt 3) 500-7 (1950).
- O. G. Sutton's theory of eddy diffusion is used to predict the dispersion of a cloud of falling droplets released from a point source at great height above the surface of the earth. Some experimental and theoretical values are given for the widths of ground area covered by liquid drops released from sources situated at heights between 1 000 and 5 000 ft, and agreement between theory and experiment is seen to be quite reasonable. This paper therefore provides further support for the use of O. G. Sutton's theory in problems of this type. The theory has practical applications, e.g. in the spraying of crops from aeroplanes. A.
- 532.61.08
556. Unstable pendant drops in relation to droplet method of surface tension. N. R. TAWDE AND K. G. PARVATIKAR. Letter in *Curr. Sci.*, **19**, 47-8 (May, 1950).
- 532.614.2
557. Correlation of liquid-solid interfacial energies calculated from supercooling of small droplets. D. TURNBULL. Letter in *J. Chem. Phys.*, **18**, 769 (May, 1950).
- 532.64
558. A convenient cell-stage for fluid profile measurements. W. FOX. *Rev. Sci. Instrum.*, **21**, 499-500 (May, 1950).

MOLECULAR THEORY OF LIQUIDS 532.7

- 532.73
559. Application of Stokes' law to estimate the solvation of ions in a solution. H. MUKHERJEE. *Indian J. Phys.*, **24**, 137-42 (April, 1950).
- Since the diameter of a solvated ion is fairly large in comparison with the distance between the molecules of the solvent, the motion of the ion under a constant force should conform to Stokes' law. The diameter, however, is not large enough to allow the solvent to be considered as a continuous medium with respect to the ion and so the law cannot be applied in its original form. By introducing, in the expression of velocity, a correction term inversely

proportional to the surface area of the ion, it has been shown that the calculated hydration values of ions relative to the hydration of H-ion are in close agreement with the experimental values of Washburn and Millard. A.

MECHANICS OF GASES 533

- 533.5
7060. Plated iron as a new material in vacuum technique. W. ESPE. *Slabopr. Obz.*, **11**, 31-9 (Feb., 1950) In Czech.
- The question of a reliable substitute for Ni in electronics is complicated by the fact that Ni combines a great number of valuable and important characteristics which can only be obtained, if at all, by a carefully balanced composition of baser metals, especially low-carbon Fe, alloyed with Al. Still, the best of these alloys has to be plated with Ni, in order to obtain the required surface characteristics of the Ni, for which there cannot be any substitute. The paper gives a very comprehensive and detailed survey of successful work in this direction in various countries. B. F. KRAUS

- 533.5
7061. Suppressing mercury vapor in vacuum systems. F. AYER II. Note in *Rev. Sci. Instrum.*, **21**, 496 (May, 1950).

- 533.5 : 536.629
7062. A new Pirani-type vacuum gauge. E. BLASCO AND L. MIRANDA. Note in *Rev. Sci. Instrum.*, **21**, 494-5 (May, 1950).

- 533.5 : 536.629
7063. Vacuum differential thermal analysis. W. L. WHITEHEAD AND I. A. BREGER. *Science*, **111**, 279-81 (March 17, 1950).

A description, with diagrams, is given of a vacuum furnace, the steel block containing the samples under investigation, and control and measuring equipment, suitable for differential thermal analysis of coals and organic shales and designed to operate under vacuum or inert atmosphere. The 2 kW, 110 V a.c. furnace consists of an alundum cylinder wound with chromel-A wire. Control of the heating rate from 1° to 50°C per min was made through a chromel-alumel thermocouple with junction between the centre two windings of the heater elements; 12°C per min was chosen for comparative work. Chromel-alumel wires were also used for the block temperature, and the differential, thermocouples. A pyrex bell-jar formed the vacuum envelope. S. WEINTROUB

- 533.6.011
7064. Transonic potential flow of a compressible fluid. W. R. SEARS. *J. Appl. Phys.*, **21**, 771-8 (Aug., 1950).

Even under the assumptions of irrotational, isentropic flow, which have been found generally useful for subsonic and supersonic cases, the equations of gas flow are relatively intractable for mixed, transonic situations. Approximate methods of solution used by a number of investigators are reviewed

briefly, as well as the hodograph technique, which yields exact solutions of the equations for plane flow. It is pointed out that all the methods predict smooth, potential mixed flows involving imbedded regions of supersonic speed and both acceleration and deceleration through the speed of sound. There is no experimental verification of the existence of such flows. Three possible explanations for this sharp discrepancy between experiment and perfect-fluid theory have been advanced; namely, (a) effects of viscosity, (b) non-existence of neighbouring solutions, and (c) temporal instability. These are reviewed in turn. None has led to a complete explanation, to date. Kuo's stability calculations are described briefly. His results indicate that stable, smooth, mixed flows may exist if certain conditions are satisfied. A.

533.6.011

7065. Some solutions of the equations of flow of a viscous compressible fluid. C. R. ILLINGWORTH. *Proc. Camb. Phil. Soc.*, 46 (Pt 3) 469-78 (1950).

The exact (Navier-Stokes) equations for the flow of a viscous compressible fluid are examined in a search for simple solutions, in which the equations reduce to ordinary differential equations. Such solutions are found for the uniform shearing motion in the Couette flow between both parallel flat plates and coaxial circular cylinders in relative motion. For a compressible fluid there are no simple solutions corresponding to certain other flows (such as the Poiseuille flow between fixed parallel flat plates) described by simple solutions for an incompressible fluid. A solution is found for the flow of a gas over an infinite porous plate with uniform suction through the plate (gravity neglected), and the relation of the solution to asymptotic solutions of the boundary-layer equations is discussed. Ordinary differential equations are obtained for the problems of (i) the flow due to the rotation of a horizontal disc in a gas (dissipation neglected), and (ii) the steady circulatory flow round a porous circular cylinder with uniform suction (gravity neglected). Discussion of the gas-dynamical problems is preceded by a description of the state of a horizontally stratified gas in static and thermal equilibrium. A.

533.6.011

7066. High-speed flow of a gas past an approximately elliptic cylinder. H. C. LEVEY. *Proc. Camb. Phil. Soc.*, 46 (Pt 3) 479-91 (1950).

A family of exact solutions of the problem of 2-dimensional flow of a compressible perfect fluid about a cylinder is found, the solutions being generalized from those for the flow of an incompressible fluid about an elliptic cylinder of arbitrary eccentricity and angle of attack. The circulation is taken to be zero and the speed of the fluid at infinity subsonic. This analysis is an application of the general theory given by Cherry [Abstr. 543 (1947) 1751 (1949)]. A.

533.6.011

7067. Asymptotic expansions for the hypergeometric functions occurring in gas-flow theory. T. M. CHERRY. *Proc. Roy. Soc. A.*, 202, 507-22 (Aug. 22, 1950).

Asymptotic formulae of two sorts are found for

the hypergeometric functions, of large order v which arise when gas-flows are investigated by the hodograph method. These functions are monotonic for "subsonic" values of the argument τ , oscillating for "supersonic" values. (i) Elementary formulae involving exponential or circular functions and singular at the sonic value $\tau = \tau_s$, are developed to the terms in v^{-4} . When τ is near τ_s these formulae give poor approximation. (ii) Formulae giving uniform approximation near τ_s , involving Bessel functions, are developed to the terms in v^{-4} . These give 7-figure accuracy over the physically significant range of τ , for $|v| \geq 10$. The coefficients are tabulated for $\tau = 0(0.02)0.50$ for the case where the adiabatic index γ of the gas is 1.4. A.

533.6.011.311 : 536.24

Contributions to the theory of heat transfer through a laminar boundary layer. See Abstr. 7189

533.6.011.5

7068. Notes on gas flow through a nozzle. A. M. BINNIE. *Proc. Camb. Phil. Soc.*, 46 (Pt 3) 492-9 (1950).

The oscillations are examined which may develop in supersonic flow through the divergent part of a nozzle. Hooker's theory is found to be confirmed by observations on a steam nozzle. It is shown that Taylor's approximate theory of flow between circular arcs can also analyse the throat conditions when the velocity of approach to the throat is supersonic. Limiting symmetrical flow occurs when the velocity at the centre of the throat just exceeds the local velocity of sound, no matter what the radii of the arcs and the ratio of the specific heats of the gas may be. The unique asymmetrical case is merely the reverse of Taylor's solution for the flow when the velocity of approach is subsonic. A numerical comparison has been made of the velocities across the throat as calculated by Taylor's method and by Fox and Southwell's iterative process when the velocity of approach is subsonic. The agreement is good for limiting symmetrical flow but not so satisfactory for the unique asymmetrical case. A.

533.6.011.5

7069. Results of recent hypersonic and unsteady flow research at the Langley Aeronautical Laboratory. J. V. BECKER. *J. Appl. Phys.*, 21, 619-28 (July, 1950).

533.6.011.5 : 541.127

7070. Application of near-equilibrium criteria during adiabatic flow to representative propellant systems. S. S. PENNER. *J. Franklin Inst.*, 249, 441-8 (June, 1950).

533.691

7071. On the linearized potential theory of unsteady supersonic motion. K. STEWARTSON. *Quart. J. Mech. Appl. Math.*, 3, 182-99 (June, 1950).

The Laplace transformation is applied to several problems of unsteady supersonic flow, assuming that the approximations of the linearized potential theory are valid. Simple expressions for the lift-distributions on the semi-infinite wing, the swept-back wing, and the slender body of revolution at incidence are obtained. A method for obtaining a power series for the lift on a "Delta" wing is also given. A.

MOLECULAR THEORY OF GASES 533.7

533.7
7076. Compressibility of gases at high temperatures. The second virial coefficient of helium in the temperature range 600°C to 1200°C. J. L. YNTEMA AND G. SCHNEIDER. *J. Chem. Phys.*, **18**, 641-6 (May, 1950).

An apparatus is described for measuring the second virial coefficient of gases up to 1200°C. The method of measurement is based on a modification of an expansion method described previously [Abstr. 7073 (1949)]. Results of measurements of the second virial coefficient of helium at 600°, 800°, 1000° and 1200° are given. A.

533.7
7077. On the intermolecular potential of helium. J. L. YNTEMA AND W. G. SCHNEIDER. *J. Chem. Phys.*, **18**, 646-50 (May, 1950).

Experimental values of the second virial coefficient of helium from 0°C to 1200°C [see Abstr. 7072 (1950)] were used to test various intermolecular potential functions for helium. A Lennard Jones potential, $E(r) = -\epsilon - \mu r^{-m}$, with $m = 6$ and with n either 9 or 12 could not be made to fit the experimental data over the entire temperature range. The coefficients λ and μ derived from the data showed a marked temperature dependence. The theoretically calculated potentials of Slater and Kirkwood and of Margenau were used to give values of the second virial which were approximately 8.5% and 27% lower, respectively, than the experimental values. A potential function with exponential repulsion, which gives a more satisfactory fit with the experimental data, was derived empirically. A semi-empirical expression given by Keyes for B as a function of temperature is also compared. A.

$a_n \leq 0$, static instability; $D_{n-1} \geq 0$, dynamic instability. Stability occurs only if all the D_i are positive.

L. S. GODDARD (R)

534.13 : 621.3.012.8 : 621.317.39
7076. An equivalent circuit for a vibrating beam which includes shear motions. H. M. TRENT. *J. Acoust. Soc. Amer.*, **22**, 355-7 (May, 1950).

Often, the lower normal modes of slim but complicated structures can be computed with sufficient accuracy if the computations are based upon a tapered continuous beam in which the stiffness and inertia of the beam match those of the structure at a large number of points along its length. Shear motions play a dominant role in these calculations. Even with the continuous beam approximation, the numerical computations involved are lengthy. An equivalent electric circuit for the beam makes it possible to substitute model experiments for long calculations. It is shown that such an equivalent circuit can be constructed from lumped passive components. With such a circuit it is possible to determine experimentally the gross responses of the structure to an arbitrary excitation. A.

534.21 : 534.321.9
7077. The absorption of ultrasonic waves in propionic acid. J. LAMB AND D. H. A. HUDDART. *Trans. Faraday Soc.*, **46**, 540-5 (July, 1950).

Gives results of measurements of the absorption and velocity of propagation in propionic acid over the frequency range 1 to 15 Mc/s and at temperatures from 7°C to 55°C. The occurrence of a relaxation process is confirmed, and the results are compared with previous measurements on acetic acid. The activation energy associated with the molecular equilibrium, which is perturbed by the ultrasonic vibrations, is evaluated as 7.5 kcal/mole. A.

534.21 : 534.321.9 : 532.7
7078. Effect of temperature on ultrasonic absorption in acetic acid. R. N. GHOSH AND G. S. VARMA. *Indian J. Phys.*, **24**, 125-30 (March, 1950).

The theory of ultrasonic absorption based on the structural changes in the quasi-crystalline structure of the liquid state has been applied to acetic acid. Variation of maximum absorption frequency with the variation of temperature (20°C to 65°C), as observed by Lamb and Pinkerton, has been explained by this theory. A.

534.21 : 541.68
Structural absorption of ultrasonic waves in ethyl alcohol. See Abstr. 7580

534.222 : 534.321.9
7079. On ultrasonic scattering by polycrystals. H. B. HUNTINGTON. *J. Acoust. Soc. Amer.*, **22**, 362-4 (May, 1950).

The scatter in phase which occurs when a beam of ultrasonic radiation transverses a polycrystalline medium is here treated as a stochastic process. This approach leads to an attenuation from polycrystalline scattering proportional to the grain size divided by the square of the wavelength. Whereas prior treatments of this subject are valid for the wavelengths either much smaller or much larger than the grain size, the method used here holds best over the intermediate frequency range. A.

VIBRATIONS . ACOUSTICS 534

534.01
7074. Self-oscillating systems with 2 degrees of freedom in the case of multiple frequencies. M. E. LABOTINSKIĬ. *J. Exp. Theor. Phys.*, USSR, **20**, 21-6 (May, 1950) In Russian.

A general consideration of self-oscillating systems, similar to the conditions of linear conservative systems with two degrees of freedom, on Poincaré-Lyapunov's method, for the case of multiple frequencies.

B. F. KRAUS

534.1 : 621-752
7075. On the use of Hurwitz determinants in the presentation of the domain of stability in problems of self-oscillation. E. SPONDER. *Schweiz. Arch. angew. Wiss. Tech.*, **16**, 93-6 (March, 1950) In German.

The systems considered depend on 2 parameters α and γ and the oscillations are given by an equation $a_1(x,y)\lambda^{n-1} + \dots + a_n(x,y) = 0$. The use of Hurwitz determinants $D_1, \dots, D_n$ in determining the type of oscillation is explained. The regions of stability are represented in the x, y -plane as follows:

534.222.2

7080. Pressure behind a shock wave diffracted through a small angle. C. H. FLETCHER, D. K. WEIMER AND W. BLEAKNEY. Letter in *Phys. Rev.*, **78**, 634-5 (June 1, 1950).

534.231

7081. The mean pressure and velocity in a plane acoustic wave in a gas. P. J. WESTERVELT. *J. Acoust. Soc. Amer.*, **22**, 319-27 (May, 1950).

The 1-dimensional wave equation is discussed to the 2nd order of approximation by means of a transformation that carries the equation from the Eulerian to the Lagrangean form. Airy's solution to this equation in Lagrangean form has been shown by Fubini to be an excellent approximation to an exact solution of Earnshaw's equation of motion; therefore, Airy's solution is chosen as the basis for much of this discussion. An expression for the local mean hydrostatic pressure in a plane progressive wave is obtained by transforming Airy's solution from particle to local coordinates. In a similar way, the particle velocity in fixed coordinates is shown to possess a time-independent component proportional to, and in a direction opposite to, the intensity vector. This d.c. counter-velocity is predicted without recourse to viscous forces and is compatible with zero average mass velocity. For a sound pressure level of 151 db in air there should exist a steady particle velocity of 1 cm/sec. Small particles suspended in the field can, under certain circumstances, acquire this velocity. An approximate treatment is suggested for handling 2nd-order effects arising from stationary field configurations. The influence of viscosity is discussed qualitatively.

A.

534.232

7082. Performance of conical horns. M. MOKHTAR AND G. ABDEL MESSIH. *Proc. Math. Phys. Soc. Egypt*, **4**, 27-34 (May, 1949).

The radiational properties of conical horns of small apical angles are studied by the aid of a hot wire anemometer and a "Pitot" pressure tube. The results show that long narrow cones are selective radiators to their resonant frequencies, but the selectivity diminishes as the cone gets shorter or as it resonates to a high overtone. The energy radiated increases with the length of the cone and reaches a maximum at a certain optimum angle depending on the length of the cone.

A.

534.232

7083. Development and practical application of Melde's experiment. M. MARTENOT. *C.R. Acad. Sci., Paris*, **230**, 2164-6 (June 19, 1950) In French.

A new kind of sound "diffuser" (loud speaker) is described in which the principle of Melde's experiment (a wire set in transverse vibration by means of the prong of a tuning fork) is extended. 12 wires are now attached to a vibrating plate (electromagnetically excited at the frequencies to be radiated)—the wires being graded in diameter and length so as to tune to all the notes between C_2 and C_3 inclusive. When the wires are excited at the fundamental frequencies they produce a sound of great purity. Every string will vibrate clearly up to its 7th harmonic—the arrangement of 12 strings, each covering 6 octaves, is therefore equivalent to 72 strings which

would normally be necessary. The sound emitted particularly sonorous, even a short heavily-damped input resulting in a particularly resonant vibration (as in a large room or a cathedral). The exceptional quality of the sound produced by this multistring "diffuser" also results in a stereophonic effect.

A. B. WOOL

534.232

7084. On rate of reflection of sound wave of known wave-length. F. KITO. *J. Soc. Appl. Mech., Japan* (No. 15) 51-4 (1950) In Japanese.

Assuming the wavelength of sound wave (emitted from a point source) to be very long, the rate of reflection of the wave impinging upon a solid body (ellipsoid, circular cylinder, etc.) has been calculated approximately. It is based on the theory of impulse generation of fluid motion, treated in hydrodynamic

534.321

7085. Proposal for a new fixed sound: G_3 frequency 384. Whence A_3 is frequency 432. R. DUSSAN. *C.R. Acad. Sci., Paris*, **230**, 2150-2 (June 19, 1950) In French.

A discussion of the musical standard of pitch (frequency) in use in various countries. It is concluded that it is desirable that musicians and physicists should adopt the same musical scale, based on frequency of 384 for G_3 .

A. B. WOOL

534.321

7086. A new frequency-modulation method for measuring ultrasonic absorption in liquids. E. R. CHESTER. Letter in *Nature, Lond.*, **165**, 970 (June 1, 1950).

534.321.9 : 621.396.615.1

7087. Pin-pointing ultrasonic energy. H. J. DAN AND J. L. VAN METER. *Electronics*, **23**, 84-5 (April 1950).

A magnetostriction generator provides a finely concentrated beam of ultrasonic energy which can be used to record on sono-chromotropic paper without actually touching it. A 805 triode drives a $\frac{3}{8}$ in dia. Ni-alloy tube rigidly held at its centre by split brass collar. Similar grid and anode coils are used and d.c. bias, provided by the anode current, ensures that the element vibrates at the applied frequency. A choice of feedback capacitors between anode and grid permit several operating frequencies between 10 and 28 kc/s. Slits in the tube help to dissipate heat. Focusing is effected by terminating the tube with blunt cones and drilling a small hole axially in the blunt point. The energy available at the point of focus is 2W.

H. G. M. SPRATT (U.K.)

534.322.1 : 787.7

7088. The sound character of old Italian 'master' violins. E. ROHLOFF. *Z. angew. Phys.*, **2**, 145-5 (April, 1950) In German.

Deals with the long standing problem of the difference in tone of an old master violin (e.g. Stradivari or Guarneri-del-Gesu) and a good modern violin. Comparisons are made of the sound spectra obtained for the corresponding strings of the old (e.g. 1715 "Strad") and modern (1936) violins and differences in the higher frequency overtones are pointed out. The work of H. Meinels [*Akust. Z.*]

13 (1939)], in which amplitude-frequency curves obtained for 240 old Italian and modern violins, examined critically, in order to discover the secret of the "old master violin tone." Two characteristics discussed, (1) strength of fundamental tone relative to the overtones above 3 000 c/s, and (2) strength of overtones in the frequency range 300 to 4 000 c/s.

A. B. WOOD

534.39

98. On the radiation pressure of spherical waves. LUCAS, C.R. *Acad. Sci., Paris*, **230**, 2004-6 (June 5, 1950) *In French*.

Most investigations of radiation pressure due to sound waves have hitherto been concerned with progressive waves and stationary waves. Unlike these cases, with spherical waves near a small vibrating source the density of the kinetic energy is greater than the density of potential energy. It is shown that the radiation pressure for spherical waves $= W_p \times (1 + 3d \log V/d \log \rho)$ (where W_p is the density of potential energy, V is the velocity of sound and ρ the density of the medium). The numerical factor 3, characterizing the problem of spherical symmetry, is significant, for it is here that the result differs from Brillouin's result for plane stationary waves in which this factor is unity. The difference is in effect very small, for in all practical cases $d \log V/d \log \rho$ is insignificant and $\delta p = W_p$ in all cases.

A. B. WOOD

534.39 : 541.124

99. Chemical action of sound waves on aqueous solutions. N. MILLER. *Trans. Faraday Soc.*, **46**, 53-50 (July, 1950).

Experimental data are presented which confirm that the oxidative action of intense sound on dilute aqueous solutions of inorganic reducing agents is an "indirect" process, i.e. that it is due to reactive fragments produced in the disruption of water molecules by the sound. Possible methods by which a portion of the energy of the sound is degraded in this way are discussed briefly.

A.

534.6 : 621.392.52

91. Universal filter. A. K. NIELSEN. *Ingeniøren*, **4**, 478-81 (June 10, 1950) *In Danish*.

Circuit diagrams, frequency characteristics and a photograph illustrate a description of a set of 21 bandpass filters covering the range 80-8 060 c/s, each filter provided with a key for switching in or off, and an attenuation element. Each filter consists of a capacitance-coupled series-resonance circuit and the apparatus is designed for acoustic measurements in buildings. Inductive coupling and selective-amplifier circuits are discussed as alternatives, rejected in favour of capacitance-coupling.

J. A. WILCKEN (R)

534.612 : 612.85

92. Sound measurements for psychophysical tests. A. A. MUNSON AND F. M. WIENER. *J. Acoust. Soc. Amer.*, **22**, 382-6 (May, 1950).

The results of psychophysical tests on the auditory sensory system usually show much more variability than experiments involving only physical measurements of sound waves. This has resulted in the general impression that the variance of measurements

of the auditory threshold and other psychoacoustic measurements is largely due to the inability of the observers to give consistent responses. This paper reports the results of a series of threshold measurements made under carefully controlled conditions and accompanied by search tube measurements of the sound pressures in the ear canals of the observers. The small variances obtained under certain conditions suggest that the large variability oftentimes experienced in psychophysical work is partly due to inadequate techniques for measuring the levels of the stimuli that activate the sensory system.

A.

534.7 : 612.85

7093. Subjective measurements in acoustics. D. B. FRY. *Nature, Lond.*, **165**, 950-2 (June 17, 1950).

Short report of a Physical Society discussion meeting.

534.78

7094. The apparent source of speech in the mouth. M. E. HAWLEY AND A. H. KETTLER. *J. Acoust. Soc. Amer.*, **22**, 365-9 (May, 1950).

Investigation of the sound pressure on the axis of the mouth indicates the existence of a point which may be represented as the source of speech sounds. The location of this point is dependent upon the particular speech sound, the intensity with which it is uttered, and upon the frequency components under consideration. Using young, average, male speakers, this apparent source of speech was located for 18 frequency bands covering the portion of the spectrum which contributes to speech intelligibility in each of 38 fundamental speech sounds.

A.

534.839 : 621.396.822

7095. Electrical noise. D. MAURICE, G. F. NEWELL AND J. G. SPENCER. *Wireless Engr*, **27**, 2-12 (Jan., 1950).

Describes experiments made to determine subjectively how much noise can be tolerated when listening to a programme from a loudspeaker, and also to devise an instrument to measure it. A block schematic and a photo of the listening room are given. In the latter the listener can by means of a key obtain one of 17 different noises (which are described) and compare it with a reference noise. Six different types of noise meter were used, and their characteristics are described. Curves are given showing (a) annoyance and loudness as a function of receiver bandwidth, (b) annoyance as a function of pulse-repetition frequency for both random and constant pulses. Tables are also given for other relationships. No meters were found to be entirely suitable for all cases, but from the results a specification has been drawn up for producing one.

B. B. AUSTIN (R)

534.843

7096. Pulse statistics analysis of room acoustics. R. H. BOLT, P. E. DOAK AND P. J. WESTERVELT. *J. Acoust. Soc. Amer.*, **22**, 328-40 (May, 1950).

This paper introduces a pulse statistics point of view which takes immediate account of the pulse-like nature of common sounds. Fundamentally, the method consists in examining the response of the room to a short pulse. The walls are replaced by an

array of image sources (simple images if the walls are hard, or appropriately modified if there is absorption). These image arrays are then considered statistically. Idealized experiments in a hard-walled rectangular room are employed to illustrate the essential features of this approach. A point source emits an exponential damped 3600 c/s wavetrain of about 2 msec duration. The received signals are recorded logarithmically on an oscillograph and the system is calibrated for quantitative results. Several dozen discrete reflections can be measured and correlated with calculation. The pulses merge into a more or less continuous background after a time that is calculated and confirmed experimentally. Detailed differences arise according to the positions of the source and microphone in the room. A.

534.843

7097. Transient sounds in rooms. D. MINTZER. *J. Acoust. Soc. Amer.*, 22, 341-52 (May, 1950).

The propagation of transient sound waves in bounded 1- and 3-dimensional regions is studied by means of Laplace transform methods. In the 1-dimensional case, a plane wave is considered propagated down a rigid-walled tube from a source at one end toward an acoustic termination at the other end. The velocity potential for an arbitrary particle-displacement input is found as a series, each term of which represents the effect of a reflection from the ends of the tube. In the 3-dimensional case a spherical wave from an arbitrary input source is considered, first in an unbounded region, and then in regions containing 1 wall, 3 perpendicular walls, and 2 parallel walls; finally, the case of a point source in a rectangular room is solved. An image method is used, the results being found in the form of a series whose terms represent reflections from individual walls, as well as cross-reflections between walls. The terms of the series are in the form of plane-wave expansions around the image points; these integrals are approximated by the method of steepest descents. In the last section some sample calculations are made for both the 1- and 3-dimensional systems. A.

534.844

7098. Rooms with reverberation time adjustable over a wide frequency band. P. ARNI. *J. Acoust. Soc. Amer.*, 22, 353-4 (May, 1950).

A broadcasting studio with variable reverberation characteristics is described. Of special interest is the construction of the absorbing units which enable the reverberation time to be varied evenly over a relatively broad frequency range. A.

534.845

7099. A review of the absorption coefficient problem. H. J. SABINE. *J. Acoust. Soc. Amer.*, 22, 387-92 (May, 1950).

The general problem of applying existing theory to the establishment of consistent methods of measuring and rating acoustical materials is outlined from the viewpoint of the manufacturer. Directions of further development in theory and experimental attack are suggested. A.

534.851 : 621.395.625.2

7100. Determining the tracking capabilities of a

pickup. H. E. ROYS. *Audio Engng*, 34, 11-138-40 (May, 1950).

An inter-modulation technique is described by which either a listening test can be applied or amplitude characteristics taken under various pick-up loading conditions. For the tests, two special records, one for 78 r.p.m. and the other for 45 r.p.m., are used, the two recorded frequencies being 0.4 and 4.0 kc/s with the level of the latter 12 db below that of the former. Levels ranging from -6 to +10 db and from -4 to +10 db in 2 db steps are provided for the two records respectively, the reference level being assumed normal recording levels. Corresponding velocity figures are given as well as the cutting stylus radii and recommended radii for the pick-up needles. The recorded signal passes from the pick-up through a 1.6 kc/s high-pass filter amplifier, also a rectifier, a 1.2 low-pass filter, and hence to a valve voltmeter. The voltmeter reading is a measure of the distortion and several curves are shown of its value against recording level for different values of vertical force applied to the pick-up. Comparison with the listening tests is discussed. The use of this type of test for studying the effects of various damping agents is also considered.

H. G. M. SPRATT (R)

534.851 : 621.395.625.3

7101. The determination of gramophone pick-up tracking weights. E. S. MALLETT. *Electronic Engng*, 22, 196-8 (May, 1950).

Tracking weights, as well as frequency response and impedance to lateral motion, in typical moving-iron pick-ups, depend upon the compliances and masses of the pick-up, needle, and record material. Analysis indicates the existence of three resonances of which two present a high impedance to the record groove and a peak in frequency response while the third which lies between them, has opposite effects. Expressions for the max. force between needle and record and the max. permissible velocity of cut are derived as well as those for vertical amplitude and acceleration arising from pinch effect. The total min. tracking weight is determined for a commercial record, needle, and pick-up. In practice, faulty operation arises mainly from failure to keep both peaking resonances outside the recorded range. Furthermore, most commercial records suffer from excessive radius-modulation.

H. G. M. SPRATT (R)

534.851 : 621.395.625.3

7102. Pitch fluctuations of musical recordings due to rotational irregularities of the disks. M. BRESSIN. *Radio Franç.* (No. 3), 14-16 (March, 1950) *In French*.

Brief experiments carried out in an anechoic room to determine the min. % audible change in pitch at various frequencies, when the pitch fluctuation rate is 1.2/sec, show figures ranging from 0.5 to 0.15%. The latter occurs at 2 kc/s, the frequency of greatest sensitivity. These figures may, however, fall appreciably for a room of irregular shape owing to interference patterns. Rotational irregularities are due to (a) variations in height of the disc and (b) radial eccentricity, of which (b) is likely to be the greater. It is assumed that the modern driving motor is unlikely to exhibit torque irregularities, but the combined effects

(a) and (b) may amount to 0.8%. A testing procedure for this pitch variation with a c.r.t. and a beating oscillator is described.

H. G. M. SPRATT (R)

534.851 : 621.395.625.3

703. Applications of dynamic analogues to recording and reproducing heads for gramophone discs. G. ROUCHIER. *Radio Franç.* (No. 4) 9-16 (April, 1950) French.

The electrical analogues of the component parts of a moving-iron recording head are given and the complete equivalent circuit presented. The method of determining the needle velocity in terms of the driving force and the circuit constants is shown. A table of computations is given for this velocity over the complete a.f. range for specific component values, including 3 different values of the damping resistance imposed by the rubber supports, together with the resulting frequency characteristic curves. A conventional type of moving-iron pick-up is similarly treated. Brief reference only is made to light-weight pick-ups with sapphire needles.

H. G. M. SPRATT (R)

534.86 : 621.395.612.4

704. The KB-3A high-fidelity noise-cancelling microphone. L. J. ANDERSON AND L. M. WIGINGTON. *Audio Engng.* 34, 16-17, 30 (April, 1950).

Discusses the requirements of a microphone of high fidelity for close-talking which discriminates against background noise and has low acoustic feedback. The design of a small velocity ribbon type microphone is then described and expressions for the output are given in terms of the acoustical equivalent network. Performance curves are given showing the output given by sounds at different distances from the microphone.

B. B. AUSTIN (R)

534.86 : 621.395.665.1

705. The "Expressor" system for transmission of music. R. VERMEULEN AND W. K. WESTMUIZE. *Philips Tech. Rev.*, 11, 281-90 (April, 1950).

In systems for sound transmission with a wide frequency band the difference between the level at which overloading starts and the level of background noise is less than the difference that may occur in orchestral music between the loudest passages and the noise in the concert hall, so that one is faced with the necessity of applying compression in order to avoid both overloading and high background noise. In the reproduction of the music the original dynamic differences can be regained by means of expansion. It is claimed that adjustment of the compression by a capable hand has great advantages over automatic control. With non-automatically adjusted compression, however, there is no unambiguous relation between the intensity of the original music and that of the input signal of the expander, and consequently special measures have to be taken to ensure that the expander always exactly compensates the compression. In the "Expressor" system a pilot signal causes the potentiometer of the expander to follow continuously the movements of the compressor. This pilot signal is transmitted via a separate channel and may consist, for instance, of impulses. If Philips-Miller tape is used as a sound record the pilot signal can be registered on the same tape in two pilot tracks (one for each direction of rotation of the compressor).

A.

OPTICS. RADIATION. SPECTRA 535

535.222

7106. A measurement of the velocity of light. R. A. HOUSTOUN. *Proc. Roy. Soc. Edinb. A*, 63 (Pt 1) 95-104 (1950).

The author has already described a new method of measuring the velocity of light, which replaces Fizeau's toothed wheel by a piezo-quartz [Abstr. 2643 (1941)]. This acts as an intermittent diffraction grating, and it interrupts the beam 200 times more rapidly than Fizeau's wheel did. The present paper describes the application of the method to the measurement of the velocity of light in air. The total length of path was 78 m. The frequency of interruption was measured by comparison with the Droitwich radio station. The result reduced to vacuum is 299 775 km/sec and is in agreement with other recent determinations, but, as a result of the experience gained, it will be possible to increase the accuracy at least ten times.

A.

535.23

7107. The emission of radiation from diatomic gases. I. Approximate calculations. S. S. PENNER. *J. Appl. Phys.*, 21, 685-95 (July, 1950).

An approximate method for estimating radiant heat transfer from gaseous emitters is proposed. An average absorption coefficient is used for the effective width of an entire vibration-rotation band. The procedure for determining an average absorption coefficient in terms of the integrated absorption is justified, approximately, for very small optical densities and also for large total pressures where the spectral half-width is no longer small compared with the rotational spacing. Because of these limitations it is to be expected that the procedure proposed here will be particularly useful only in estimating gaseous emissivities for emitters in high-pressure combustion chambers. A preliminary compilation is given of the theoretical results which are necessary for making rapid estimates of the emissivities, over a wide temperature range, for CO, HI, HBr, HCl, and HF.

A.

535.241 : 628.97

7108. New scale of relative footcandles for the Luckiesh-Moss visibility meter. M. LUCKIESH, S. K. GUTH AND A. A. EASTMAN. *Illum. Engng., N.Y.*, 65, 211-15 (April, 1950).

Shows how a scale can be constructed to give the value of foot-candles required for a specified "visibility-level" on the Luckiesh-Moss scale. This is done by relating the required illumination to the illumination which gives threshold visibility. The validity of the method depends on the assumption that the ratio of the f.c. for a specific visibility level to the f.c. for threshold visibility is independent of the nature of the task. Experimental verification is given.

J. W. T. WALSH

535.247.4

7109. Notes on some methods for measuring small light intensities. P. S. FARAGÓ. *Hungar. Acta Phys.*, 1 (No. 6) 9-13 (1950).

Discusses the 2 methods commonly used for

measuring very small light intensities with a multiplier photocell, viz. (i) direct measurement of the photocurrent due to continuous exposure, and (ii) modulation of the incident beam at some convenient frequency. The most favourable method depends on the conditions met with, particularly as regards the light intensity to be measured.

J. W. T. WALSH

535.316

7110. Matrices and the theory of optical instruments. III. T. SMITH. *An. Real Soc. Esp. Fis. y Quim.*, **45A**, 483-96 (Nov.-Dec., 1949) *In Spanish*.

Having in previous papers [Abstr. 4802, 5672 (1950)] considered Snell's law in relation to optical instruments, Hamilton's function is now developed, remembering that matters relating to the propagation of light were undecided when he wrote. It is shown that simple matrices may be used to determine the functions of indices of refraction, curvatures, etc., which represent the properties of instruments.

W. A. RICHARDSON

535.317 : 621.385.833

7111. On the energy-flow distribution in certain types of paraxial beams. R. DORRESTEIN. *Philips Res. Rep.*, **5**, 116-27 (April, 1950).

In a paraxial beam proceeding along the axis of a rotationally symmetric (light-optical or electrostatic) refractive medium, special pairs of cross-sections may exist, in which the corresponding distributions of energy current density (or intensity) are mutually independent. They are called "independent" cross-sections. From the intensity distributions in two such independent cross-sections, one can calculate the intensity distributions in any other cross-section by means of a suitable composition-product integral. The "Gaussian beam" is defined by a Gaussian intensity distribution and a Gaussian angular energy-flow distribution in one cross-section. This class of beams possesses an infinite number of pairs of independent cross-sections. The equation for the effective radius s , as a function of the distance z along the axis, is identical with the paraxial-ray equation for $r(z)$ in cylindrical coordinates z, r, ϕ .

A.

535.317.9

7112. Application of an aspherical surface to an ocular. L. REYMOND. *An. Real Soc. Esp. Fis. y Quim.*, **45A**, 497-502 (Nov.-Dec., 1949) *In Spanish*.

Considering an ocular, consisting of a plano-convex lens, whose plane face is towards the eye, it is shown that astigmatism and field curvature can be eliminated together.

W. A. RICHARDSON

535.33.07

7113. Spectrophotometry in the presence of stray radiation: a table of $\log \cdot [(100 - k)/(T - k)]$. A. OPLER. *J. Opt. Soc. Amer.*, **40**, 401-3 (June, 1950).

When spectrophotometry is conducted in the presence of unavoidable stray radiation, the usual expression for the absorbance [$A = \log(100/T)$] becomes $\log [(100 - k)/(T - k)]$, where T is the % transmittance ($100/I_0$) and k is the % stray radiation. To meet the demands of routine i.r. spectrophotometry in the 15-22 μ -region, a table of values of this function was prepared for $1 < T < 99$ and $0.5 < k < 20$. The calculation of these values was performed by punched card machines.

A.

535.33.071 - 15 : 537.312.2

7114. Application of lead sulphide cells to infra-red spectroscopy. R. MATHIS, F. BOSSON, G. GAUTHIER AND M. LARNAUDIE. *J. Phys. Radium*, **11**, 300-4 (June, 1950) *In French*.

The equipment included gratings, a PbS cell and a 3-stage a.c. amplifier. The galvanometer deflections were recorded, and curves of the resulting absorption spectra are given to show the resolution attained (for H₂O vapour) in the region 1.35 to 2.8 μ . Noise levels are considered.

S. T. HENDERSON

535.33.072 : 545.822

7115. Double-beam infrared spectrophotometer: Chemical and biochemical applications. J. U. WHITE. *Analyt. Chem.*, **22**, 768-72 (June, 1950).

535.33.072 : 545.822

7116. Beckman flame spectrophotometer. P. T. GILBERT, JR., R. C. HAWES AND A. O. BECKMAN. *Analyt. Chem.*, **22**, 772-80 (June, 1950).

A new flame spectrophotometer, now commercially available, is characterized by a simple detachable atomizer handling samples of 1 ml or less, a heated spray chamber for evaporating the spray, a versatile burner for oxygen-gas or other flames, and construction of the atomizer-burner unit as an attachment for the Beckman quartz spectrophotometer. Individual measurements can be made in very rapid sequence, and the precision of such measurements is a few tenths per cent of full scale. Interference effects and methods of circumventing them are discussed. Flame spectra and detection limits are given for several dozen elements, and excitation characteristics and methods of analysis are illustrated for a few cases.

A.

535.332 : 539.1533

7117. Multiplet intensities for the lines $4S - 2D$ of N I. C. W. UFFORD AND R. M. GILMOUR. *Astro-phys. J.*, **111**, 580-1 (May, 1950).

The relative strengths of the transitions $1s^2 2s^2 2p^3 \ ^4S_{3/2} - ^2D_{5/2}$ and $1s^2 2s^2 2p^3 \ ^4S_{3/2} - ^2D_{3/2}$ in N I are computed, including spin-spin interaction. The radial integral which determines the influence of spin-spin coupling on the transition probability was calculated by numerical integration with wave functions found by interpolation from those of B, C, O, F, and Ne derived from the self-consistent field. The theoretical value of the ratio of the intensities in N I for $^4S_{3/2} - ^2D_{5/2}$ and $^4S_{3/2} - ^2D_{3/2}$ is 0.83. See also Abstr. 2319 (1949).

A.

535.338 : 535.33.03

7118. Investigation of the spectrum of the high voltage arc in carbon dioxide: the CO flame spectrum. M. W. FEAST. *Proc. Phys. Soc., Lond. A*, **63**, 772-4 (July, 1950).

The spectrum emitted by a high voltage arc in CO₂ at atmospheric pressure has been investigated in the region 2 000 Å to 9 000 Å. It was found to consist, mainly, of a continuum and the "CO flame bands." A study of the spectrum at different dispersions and on photographic plates of various kinds shows that although the Schumann-Runge O₂ bands do form a part of the spectrum they are relatively weak compared

the bands attributed to CO_2 . The excitation of the Schumann-Runge O_2 system in flames is discussed. A.

535.338.333 : 539.155.2 : 539.152.1

Spectroscopic isotope shift and nuclear polarization. *Abstr.* 7431-2

535.338.4

Emission spectrum of ozone. R. HERMAN and L. HERMAN. *C.R. Acad. Sci., Paris*, **230**, 1516-18 (April 24, 1950) *In French*.

Excitation of pure O_2 at 10-20 cm Hg pressure shows a number of new bands to be distinguished from the usual Schumann-Runge system. About 30 listed, all degraded towards the red, and some of them may be attributed to O_3 . S. T. HENDERSON

535.338.4 : 536.46

Spectrum of the flame above a copper arc in air. S. P. SINHA AND S. C. PRASAD. *Indian J. Phys.*, **24**, 103-8 (March, 1950).

The spectrum of the flame above a Cu arc in air has been photographed on a glass prism spectrograph with a dispersion of about 12 Å per mm at $\lambda 5500$ Å. All the radiations between $\lambda 4800$ and $\lambda 6400$ Å have been measured. A large number of bands exist. Their origin and structure of most of them do not seem to be very well understood. A tentative arrangement for 3 systems of bands is given. A.

535.338.4-15 : 551.593.9

OH emission bands in the spectrum of the night sky. I. A. B. MEINEL. *Astrophys. J.*, **111**, 61-64 (May, 1950).

High-resolution spectra of the infrared night sky have shown conclusively that the previously unidentified infrared emissions are due to the rotation-vibration spectrum of OH. The agreement between vibrational spacing, the rotational constants, and the doublet structure of the emissions and the predicted OH structure is excellent. The observation of vibrational levels up to $v = 9$ shows that small inaccuracies exist in the currently accepted vibrational constants. A more accurate determination of these constants could be made, despite the low dispersion of the spectrograph. Other bands of this system of OH occur in the region of 1μ and may account for the radiation previously attributed to N_2 . A.

535.343-15

The infrared absorption spectra of organic substances in the glass-formation interval. S. N. ZHURKOV and B. YA. LEVIN. *Dokl. Akad. Nauk, SSSR*, **72** (No. 2) 269-72 (1950) *In Russian*.

Spectral absorption of phenolphthalein, glucose and the phenolformaldehyde resin has been examined in the near infrared ($1.2-1.8 \mu$) at temperatures between 0 and 150°. The apparatus used was described in a previous paper [*Dokl. Akad. Nauk, SSSR*, **67** (No. 1) 89 (1949)]. In phenolphthalein and in the other two substances the maximum corresponding to the "free" OH-groups increases with temperature, whereas the adjacent band of "bound" OH-groups decreases; below the glass-formation temperature, corresponding to the transition from a hard vitreous mass to a liquid of high viscosity, no perceivable changes in the spectrum are observed by heating, whereas above that temperature

the absorption rises in one band and decreases in another. It is suggested that these changes are brought about by H bridges being formed between the molecules of the glass-forming substance. The concentrations of the "free" and "bound" OH-groups are quantitatively estimated. The process follows the law of a bimolecular reaction. F. LACHMAN

535.343-15

7123. The vibrational spectra and structure of inorganic molecules. I. The infra-red spectrum of F_2O from 2.5 to 25 μ . H. J. BERNSTEIN AND J. POWLING. *J. Chem. Phys.*, **18**, 685-9 (May, 1950).

The infra-red spectrum of gaseous F_2O has been obtained from 2.5 to 25 μ at pressures of 10 mm to 600 mm Hg in a 10-cm cell and at 600 mm Hg in a meter cell. All 3 fundamentals have been observed and identified. The fine structure of a $\perp$ band was resolved and gave an estimate of the bond distance and apex angle as 1.38 ± 0.03 Å and $101.5 \pm 1.5^\circ$, respectively. The upper and lower limits of the constants of a quadratic potential function with all possible interaction constants have been obtained. A.

535.343-15

7124. The infra-red spectrum of $\text{N}^{15}\text{N}^{14}\text{O}$ and the force constants of nitrous oxide. W. S. RICHARDSON AND E. B. WILSON, JR. *J. Chem. Phys.*, **18**, 694-6 (May, 1950).

The infra-red spectrum of $\text{N}^{15}\text{N}^{14}\text{O}$ has been studied. The observed bands together with those already known for $\text{N}^{14}\text{N}^{14}\text{O}$ provide sufficient data to calculate a reasonable set of force constants for the nitrous oxide molecule. The zeroth-order stretching frequencies for $\text{N}^{15}\text{N}^{14}\text{O}$ and the force constants derived from them are also calculated. In the observed frequency approximation the N-N, N-O and interaction constants have been assigned the values 17.9, 11.4 and 1.4×10^5 dynes/cm, respectively. These values are consistent with the picture that N_2O is a resonance hybrid of the two (principal) structures $\bar{\text{N}} = \overset{+}{\text{N}} = \text{O}$ and $\text{N} \equiv \overset{+}{\text{N}} - \bar{\text{O}}$. A.

535.343-15

7125. Spectra-structure correlations in the infra-red region. N. B. COLTHUP. *J. Opt. Soc. Amer.*, **40**, 397-400 (June, 1950).

This paper presents a chart giving probable positions of characteristic infra-red absorption bands for certain molecular groupings. Both original and published data were used in its preparation. The reliability of the various correlations is discussed in the text. A.

535.343.2-15

7126. Infra-red absorption of silicon. H. Y. FAN AND M. BECKER. Letter in *Phys. Rev.*, **78**, 178-9 (April 15, 1950).

Absorptivity measurements on bulk samples of Si of different resistivities are higher than values calculated on the Drude theory for free charge carriers possibly because two-stage absorption takes place. Measurements at 100°K and 293°K are compared and at the lower temperature higher absorption is shown owing to ionization of the impurities. At room temperature it is thought that absorption is due largely to the free holes. W. R. ANGUS

10****

535.343.2 : 538.61 : 548.0

7127. The linear Zeeman effect in crystals. K.-H. HELLWEGE. *Z. Phys.*, **127** (No. 5) 513-21 (1950) *In German*.

Bethe's mathematical treatment [*Z. Phys.*, **60**, 218 (1930)] is extended to cover all the 32 point groups of symmetry. It is shown that the effect is to be observed not only if the field is parallel to the main crystallographic axis but also, in certain cases, if it is perpendicular to it. These special cases correspond to particular values of the magnetic quantum number and to particular symmetry characteristics about the main axis; they are fully enumerated.

E. P. WOHLFARTH

535.343.2 : 548.75

7128. Change of structure of crystals followed spectroscopically. A.-M. HELLWEGE AND K.-H. HELLWEGE. *Z. Phys.*, **127** (No. 4) 334-43 (1950) *In German*.

Lines in the absorption spectra of $\text{PrBrO}_3 \cdot 9\text{H}_2\text{O}$ and $\text{NdBrO}_3 \cdot 9\text{H}_2\text{O}$ alter in polarization and split into several components below 85°K , the change being most rapid in the range 75° to 65°K . A complete explanation involves a reduction of the symmetry axis from 6-fold to 2-fold or less [cf. Abstr. 5415 (1950)], and a change in the environment of some of the metal ions so that they are no longer all equivalent. (La , Pr) $(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$ shows smaller effects, the decrease being attributed to its larger lattice parameters.

A. J. C. WILSON

535.343.31-15

7129. The infra-red spectra of hydrogen and deuterium peroxides in condensed phases. R. C. TAYLOR. Letter in *J. Chem. Phys.*, **18**, 898-9 (June, 1950).

535.343.32

7130. Spectra of rare earths in solutions fluid at the temperatures of liquid nitrogen. S. FREED AND C. J. HOCHANDEL. *J. Chem. Phys.*, **18**, 780-2 (June, 1950).

Some hexahydrated rare earth nitrates and bromides were found to have solubilities at 77°K sufficient for obtaining spectra through light-paths of 25 cm. The spectra were comparable in sharpness with those from crystals of rare earths at low temperatures. Since the bands arising at room temperature were resolved into discrete lines at the low temperature, the possibility is open to investigate the symmetries and intensities of the electric fields about the positive ions in solution. Corresponding groups in the spectra from the nitrates and bromides consisted of different numbers of lines of widely different spacing. In neodymium nitrate there was a marked transformation in the structure of the spectrum when the temperature of the solution was changed from 193°K to 77°K . At 77°K there was no change observed throughout 9 days. The change with temperature was especially striking in the spectra of samarium bromide. Electrical conductances of some of the solutions were measured at 193°K and 77°K . The magnitudes were very low and strongly dependent on viscosity.

A.

535.343.32

7131. Variations in absorption spectrum of the

nitrate group. L. I. KATZIN. *J. Chem. Phys.*, **18**, 789-91 (June, 1950).

Li , Mg , Ca , Al , manganous, cobaltous, nickelous, cupric, Zn , Cd and Th nitrates, and nitric acid, show an absorption in tertiary butyl alcohol solution which is different from that of dilute aqueous solutions of nitrates. The most marked effects are shown by the transition elements with partially completed d shells. The variety of the spectra indicate that a single change such as the rearrangement of the normally planar nitrate ion into a pyramidal form, cannot account for nitrate spectrum changes.

535.343.33

7132. The asymmetric rotor. VIII. The hydrogen sulfide band at 6300 cm^{-1} . H. C. ALLEN, JR., P. C. CROSS AND M. K. WILSON. *J. Chem. Phys.*, **18**, 691-3 (May, 1950).

The absorption spectrum of H_2S in the region 6140 to 6420 cm^{-1} has been measured and the rotational fine structure analysed through the use of published energy tables for the rigid rotor and classical correction for centrifugal distortion. The excited state constants giving the best fit are $A^* = 10.39$, $B^* = 8.90$ and $C^* = 4.55\text{ cm}^{-1}$. The band centre is located at 6289.5 cm^{-1} . The value of $I_C - I_A - I_B$ and the strong Q branch, indicating the non-vanishing electric moment derivative to be along the least inertial axis, show the upper vibrational level to be the (111) state.

535.343.34

7133. Absorption of ozone in the region of the Huggins bands. Influence of the temperature. E. VIGROUX. *C.R. Acad. Sci., Paris*, **230**, 2170-1 (June 19, 1950) *In French*.

Absorption coefficients have been measured and are tabulated, showing the maxima and minima in the range 3455 - 3106 Å , for 9 temperatures between -92° and $+120^\circ$. The absorption coefficients at the wavelengths of the maxima have minimum values near -60° and show considerable increases at the highest temperatures.

G. F. LOTHIAN

535.343.4-14 : 539.155.5

7134. Microwave measurements on the stable selenium isotopes in OSe . S. GESCHWIND, H. MINDEN AND C. H. TOWNES. Letter in *Phys. Rev.*, **78**, 174-5 (April 15, 1950).

535.343.4-1

7135. Pressure broadening effects in infra-red spectra: Ozone. M. K. WILSON AND R. A. OGGS. Letter in *J. Chem. Phys.*, **18**, 766 (May, 1950).

535.343.4-3

7136. Displacements of ultraviolet absorption bands of phenanthrene dissolved in some gases under pressure up to 1200 kg/cm^2 . S. ROBIN. *C.R. Acad. Sci., Paris*, **230**, 1757-9 (May 15, 1950) *In French*.

Measurements at 0° , 17° , 50°C show the displacements are independent of temperature. For equal densities the shift depends on the solvent; but it is also a function of density for which the best account is given by the Fermi theory.

J. JACOB

535.361.1

7137. The Umov effect. A. S. TOPORETS. *J. Exp. Theor. Phys., USSR*, **20**, 390-4 (May, 1950) *In Russian*. Umov showed that selective depolarization occurs

the reflection of polarized light on a dull coloured surface. The rays suffering the strongest absorption are the minimum phenomenon, whereas those corresponding to the colour of the reflecting surface exhibit the maximum effect. The author shows that a quantitative relation exists between the weakening of light in the reflection and the degree of polarization and gives an explanation of the phenomenon. Diffusely reflected light consists of 2 components, external and internal one. Only the internal component of the polarized light is depolarized in the diffuse reflection. The degree of depolarization is the relative intensity of the internal, that of polarization is brought out by the curves of the experimental facts and the simple mathematical theory.

B. F. KRAUS

535.37

7141. Comparison of the killer actions of nickel and cobalt on luminescent zinc sulphide. J. SADDY AND J. ARBARIAN. *C.R. Acad. Sci., Paris*, **230**, 1948-50 (May 31, 1950) *In French*.

Whereas the action of Ni increases with the duration of the afterglow, with a maximum effect for 60 sec at 5×10^{-6} g Ni/g ZnS, Co is most effective during excitation. At 5.5×10^{-6} g Co/g ZnS the killer effect is at a minimum.

S. T. HENDERSON

535.37

7142. The duration of the 16 volt levels of neon. A. GRANT. *Canad. J. Res. A*, **28**, 339-58 (May, 1950).

An electronic apparatus has been developed to determine the rate of decay of the 16 volt levels of Ne after the interruption of an electrical discharge, by measurement of the absorption of a monochromatic light beam. The half-life of the $^3P_2$ metastable level has been determined as a function of pressure and discharge tube diameter. The $^3P_0$ and $^3P_1$ levels exhibit a pronounced departure from an exponential decay. The hypothesis of the imprisonment of resonance radiation is consistent with the measured variation of the $^1P_1$ and $^3P_1$ levels.

A.

535.37 : 536.48

7143. On the polarization of the phosphorescence of organic luminophors at liquid-air temperature. YA. SVESHNIKOV AND V. L. ERMOLAEV. *Dokl. Akad. Nauk, SSSR*, **71** (No. 4) 647-50 (1950) *In Russian*.

It has been suggested to extrapolate to more complex molecules the idea of the possibility of relating the spin function. It has also been suggested that the resemblance between the polarization characteristics of one of the singlet levels (absorption) and the phosphorescence level proves that the structures of the respective electron shells are similar. Gelatin films dyed with auramin and tryptaflavin, candy sugar activated with rhodulin orange, and alcoholic solutions of lucigenin, tryptaflavin, and diluted fluorescein have been examined. The results confirm the previously suggested idea [Abstr. 69 (1949)] that the molecule, when passing from the fluorescing to the metastable condition, passes

through a labile condition. When examining the dependence of the phosphorescence polarization on the wavelength of the exciting light, it has been observed that, when the excitation is in the long-wave absorption band, the phosphorescence polarization is negative for all activators, while the fluorescence polarization has in similar conditions the maximum positive value. The opposite has been found when the excitation was in the 2nd or 3rd absorption band.

F. LACHMAN

535.37 : 537.56

7141. On the luminous phenomena accompanying electrical excitation of rare gases. Case of neon. M. BAYET. *C.R. Acad. Sci., Paris*, **230**, 2016-18 (June 5, 1950) *In French*.

During the afterglow a slight increase of luminous emission is observed, with a maximum occurring at a time roughly $\propto 1/\text{pressure}$ of the gas. This is attributed to a change with electron speed of the coeff. of recombination of ions with electrons.

S. T. HENDERSON

535.371

7142. The effect of the unevenness of excitation on the flash properties of phosphors sensitive to infrared rays. L. I. ANIKINA AND V. V. ANTONOV-ROMANOV-SKII. *Dokl. Akad. Nauk, SSSR*, **71** (No. 4) 637-40 (1950) *In Russian*.

It is known that the brightness I of the flash, measured as a function of the light sum n , is considerably higher when the phosphor is storing the light sum during excitation (rising branch) than in the case of quenching under the influence of the stimulating light (falling branch). This "hysteresis" effect can be explained by causes due to (a) micro-non-homogeneousness, and (b) macro-non-homogeneousness. The SrS-Eu, Sm phosphor has been studied. The hysteresis decreases markedly with the thickness of the phosphor layer. It also decreases if excitation with diffuse light from both sides is substituted for one-sided excitation with a collimated beam. It has been found that in most cases the rising curve follows the quadratic law, viz. $I \sim pn^2$. Since in the case of quenching $I = -dn/dt (t - \text{time})$, one obtains the relationship $I \sim pn_0^2/(1 + pn_0 t)^2$, where n_0 is the initial concentration of the light sum at $t = 0$. It has been shown that the hysteresis caused by the unevenness of excitation is due to the fact that the luminescence process is not a linear one.

F. LACHMAN

535.371

7143. A striking difference between the activations of potassium and sodium halide phosphors. P. PRINGSHEIM. *Acta Phys. Austriaca*, **3** (No. 4) 396-404 (1950) *In German*.

By making KCl and NaCl crystals from aqueous solutions containing appropriate impurity traces it is found that Ti can activate KCl but not NaCl, while Mn activates NaCl but not KCl. Pb traces in NaCl enhance the luminescence due to the Mn^{++} ions by producing excitation bands in the u.v. No correlation is found between ionic radius of impurity ion and ability to activate halide phosphors.

G. F. J. GARLICK

535.371

7144. Some properties of phosphate phosphors. V. V. ZELINSKII, F. M. PEKERMANN, T. V. TIMOFEEVA AND B. I. VAINBERG. *J. Exp. Theor. Phys., USSR*, 20, 395-400 (May, 1950) In Russian.

Phosphors produced from phosphates of metals of the second group, i.e. Cd, Ca and Sr, and activated by Mn, Pb, Sb and Ce, or by combinations of Mn + Pb and Mn + Sb were investigated. Their absorption and emission spectra, quenching laws and intensity-temperature curves were established. The absorption and emission spectra are mainly determined by the activator, although the phosphor itself contributes definite characteristics. Single and dual activator phosphors can be obtained on a phosphate base, whereby the interaction between the activators may vary a good deal. Thus the phosphate of Cd + (Pb + Mn) shows absorption by both activators (the base does not absorb), and a redistribution of the emission between the activators depending on the intensity of the exciting radiation. The luminescence of the Ca phosphate, activated by Sb + Mn, represents the case of sensitized phosphorescence, because the energy is absorbed by the Sb and transferred to the Mn. The behaviour of the Mn in the lattice of Pb and Cd phosphate is interesting as deviating from the case of the Ca phosphate, where no corresponding lattice is formed. Phosphates activated by the heavy metals Ce, Pb, Sb give phosphors with a blue fluorescence spectrum, whereas Ca phosphate, activated by Ce, represents a red variant with the maximum in the u.v. Heavy-metal-activated phosphates show flash luminescence, $\tau < 10^{-5}$ sec; the Cd phosphate, activated by Pb, a persistent afterglow in addition, decaying hyperbolically. The phosphates activated by pure or combined Mn have an afterglow decaying exponentially with $\tau \approx 10^{-2}$ sec.

B. F. KRAUS

535.371

7145. Variation of the optical properties of ZnS.Cu, ZnS.Mn and ZnS.CdS.Mn phosphors caused by mechanical disintegration. V. L. LEVSHIN AND I. V. VEITS. *J. Exp. Theor. Phys. USSR*, 20, 411-20 (May, 1950) In Russian.

The crystals of a ZnS.Cu phosphor were crushed from a volume of 5 600 to one of $150 \mu^3$ and crystals of ZnS.Mn and ZnS.CdS.Mn phosphors from about 100 to $5 \mu^3$. Some fractions of each phosphor were investigated. The crushing shifts the emission spectrum, i.e. of the Zn band, to higher frequencies, the Cu and Mn bands to lower ones. The total radiance (brightness of a thick layer) varies linearly with grain volume. The quenching rate is slightly reduced by the crushing. The variation of the optical properties is not connected with the reduction of the absolute crystal size, but with the relative reduction of the original crystal volume, and determined by the internal changes of the crystal lattice. The X-ray investigation reveals the transition from the Wurtzite to the sphalerite (blende, cubic system) structure, but this does not cause a reduction of the luminous output. The X-ray diagrams further show a blurring of the interference bands and disappearance of the high-order bands for all crushed crystals, with a reduced intensity of luminescence, thus confirming the occur-

rence of internal deformations during the crushing of the crystals, and resulting in a quenching of the luminescence.

B. F. KRAUS

535.371

7146. On the phosphorescence of quartz.

AUDUBERT, M. BONNEMAY AND M. LAUTOUT. *Acad. Sci., Paris*, 230, 1771-2 (May 15, 1950) French.

The phosphorescence of quartz excited by X-rays shown to extend to $2200 \text{ \AA}$ with a maximum near $2900 \text{ \AA}$. Its duration is about 70 hrs, and it may be re-excited an indefinite number of times by irradiation with $\lambda = 2200-5500 \text{ \AA}$, even after several months. This indicates that the quartz is left in an intermediate metastable energy level of long life, which is, however, lost on heating to 380° .

G. F. LOTHIAN

535.371

7147. The rise in brightness of infra-red sensitive phosphors. P. BRAUER. *J. Opt. Soc. Amer.*, 40, 353-5 (June, 1950).

Scott, Thompson and Ellickson found that the rise in brightness of double activated i.r. sensitive phosphors such as SrS.Eu-Sm shows in some cases a jump, in others not. The jump and the slope of the curves of brightness v. time at the beginning are not proportional to the intensity of the i.r. A model of such phosphors is described and later used to calculate the curves. The resulting equations contain both the jump and the deviation of the proportionality to the intensity of the i.r., if the filling of traps is considered. The magnitude of the jump strongly depends on the height of a level.

535.371 : 536.4

7148. Resolution and analysis of low temperature luminescent spectra of Bi and Pb activated solids of simple crystal structure. J. EWLES AND C. CURRY. *Proc. Phys. Soc., Lond., A*, 63, 708-15 (July, 1950).

Experimental arrangements are described by which clearly resolved spectra have been obtained of the luminescence, at the temperature of liquid air, of 7 different phosphors of simple crystal structure (cubic) and of mixed crystals. The main peaks in each case may be arranged in a band series. The vibration frequency in the lower state is nearly the same for the same host lattice with different activators. The energy of the electronic transition is determined both by the activator and the host crystal and there is a progression of decreasing energy in the series of simple crystals MgO, CaO, SrO, CaS, and in the order CaO, CaO-SrO with mixed crystals. The most probable transitions are from the lowest level of the upper state. There is evidence that self-excitation occurs and for the view that the luminescent centres are large.

535.372

7149. Dependence of emission spectra of phosphors upon activator concentration and temperature. G. R. FONDA. *J. Opt. Soc. Amer.*, 40, 347-52 (June, 1950).

Two groups of O-containing phosphors are examined for location of their peak emission. The first group includes 5 phosphors whose emission is distributed between 2 main spectral bands to an extent dependent on activator concentration. Sufficient decrease in activator content causes all of the emission to appear in the shorter wavelength band.

increase in temperature has the same effect. In the second group, represented by 3 phosphors, the emission cannot be resolved into component bands with change in activator content. An increase in temperature shifts the emission to shorter wavelength.

A.

535.372

1. Fluorescence studies of some simple benzene derivatives in the near ultraviolet. I. Fluorobenzene and chlorobenzene. A. M. BASS AND H. SPONER. *J. Opt. Soc. Amer.*, **40**, 389-96 (June, 1950).

535.372

1. The emission bands of willemite in phosphorescence. E. NAGY. *Letter in J. Opt. Soc. Amer.*, **40**, 407 (June, 1950).

535.372 : 535.343

2. Luminescence spectra of alkali halides. N. BOSE AND J. SHARMA. *Proc. Nat. Inst. Sci. India*, **16**, 47-57 (Jan.-Feb., 1950).

The luminescence spectra of some of the alkali halides, pure and impurity-activated, under cathode ray excitation, have been investigated at ordinary and low temperatures. It has been found that pure specimens, which are non-luminescent under ultraviolet excitation, emit a spectra composed of a number of diffuse bands. The effect of different impurities, when added to the melts or as mechanical admixtures, has been investigated in some of the cases; the effect of concentration on the luminescence spectra has been studied for the system KI + Tl. Comparing the measurements with the ultraviolet luminescence spectra of impurity-activated alkali halides, it is observed that part of the emission by ultraviolet excitation can be explained as that of pure matrix emission which is obtained under X-rays or cathode rays. The existence of an emission similar to that of TlCl, in the luminescence spectra of alkali halides with high Tl content, indicates an identical environment for Tl ions in these phosphors and in thallous chloride. Easy transfer of excitation energy between the centres, induced by X-rays or cathode rays, and those due to activators, occurs very frequently and it is suspected that activation of alkali halides by Tl is a case of indirect activation, for that part of the spectrum, which is common in the activated and pure alkali halides, under u.v. and X-ray or cathode ray excitation respectively.

A.

535.375 : 537.347

53. Influence of torsional vibrations of luminescent molecules on the fundamental polarization of photoluminescence of solutions. A. JABŁOŃSKI. *Acta Phys. Polon.*, **10** (No. 1-2) 33-6 (1950).

The observed values of fundamental polarization are always smaller than those to be expected on the ground of theoretical considerations. This fact can be explained (at least partially) by the influence of torsional vibrations of fluorescent molecules on the rate of polarization of photoluminescence. Some conclusions can be drawn from the difference between theoretical and experimental values of the polarization. This note contains some provisional results of theoretical investigation.

A.

535.375.5

54. Application of a better approximation in the evaluation of the Raman frequencies of the conjugated

carbonyl group. E. SCROCCO AND P. CHIORBOLI. *Atti Acad. Naz. Lincei (R.C. Cl. Sci. Fis. Mat. Nat.)*, **8**, 248-53 (March, 1950) *In Italian*.

535.375.5

7155. Low-frequency Raman-spectra of the crystals of para-, meta- and ortho-di-iodobenzenes. E. F. GROSS, A. V. KORSHUNOV AND V. A. SELKIN. *J. Exp. Theor. Phys., USSR*, **20**, 292-6 (April, 1950) *In Russian*.

An important result is the relation between the squares of frequencies of homologous lines of isomorphous crystals and the corresponding moments of inertia, viz. $\nu^2/\nu'^2 = I'/I$, which was verified for para-dichlorobenzene, para-dibromobenzene, para-bromochlorobenzene and para-di-iodobenzene. B. F. KRAUS

535.375.5

7156. Polarization in the Raman spectra of aromatic nitro compounds. YA. S. BOBOVICH AND M. V. VOLKENSHTEIN. *Dokl. Akad. Nauk, SSSR*, **71** (No. 6) 1045-8 (1950) *In Russian*.

Reference is made to previous Russian work on the abnormally high intensities of characteristic lines in the Raman spectra of non-additive compounds. This effect is particularly pronounced in aromatic nitro compounds. A table is given containing data relating to the degree of depolarization and the intensity of the line of the full-symmetry valency vibration of the NO₂ group in 15 compounds, this line displaying strong anomalies of intensity.

F. LACHMAN

535.375.5

7157. Investigation of the degree of acidity of some alcohols and of phenol by the Raman effect. M. I. BATUEV, A. P. MESHCHERYAKOV AND A. D. MATVEEVA. *J. Exp. Theor. Phys., USSR*, **20**, 318-22 (April, 1950) *In Russian*.

535.375.5 : 532.74

7158. Investigation of the association of a series of mono-atomic [monohydric] alcohols by Raman spectra. V. I. MALYSHEV AND M. V. SHISHKINA. *J. Exp. Theor. Phys., USSR*, **20**, 297-303 (April, 1950) *In Russian*.

The band of the oscillations of the OH-group has two maxima at 3 400 and 3 630 cm⁻¹, respectively attributed to associated and dissociated alcohol molecules. The relative intensity of these maxima depends on the temperature as well as on the size and structure of the hydrocarbon part of the alcohol molecule. The lower frequency, characteristic of associated molecules, indicates a strong excitation of the O-H oscillation by the oxygen of the adjacent molecule entering into an H-bond with the first. This basic phenomenon is overlaid by a secondary effect due to inescapable variations of the intensity of the excitation by density and orientation fluctuations; the OH-line of the associated molecules thus degenerates into a band of varying width. The molecules of the solvent intervene, preventing a mutual approach and orientation favourable to formation of H-bonds of the alcohol molecules.

B. F. KRAUS

535.375.5 : 548.7

7159. Molecular scattering of Iceland spar. G. P. MOTULEVICH AND Z. M. TUROVISEVA. *J. Exp. Theor. Phys., USSR*, **20**, 334-9 (April, 1950) *In Russian*.

The intensity, polarization and frequency of light scattered by Iceland spar in three orientations of the

crystal is calculated on a theory given previously by Motulevich [Izv. Akad. Nauk SSSR, Ser. Fis. 11, 390 (1947)]. The anisotropy of the total scattering was determined experimentally and the agreement between theory and experiment was found to be very satisfactory within the limits of experimental errors which in this case are considerably aggravated by unavoidable lattice errors of some importance. The correctness of the authors' theory is further supported by previous measurements of other workers and by results obtained on quartz and NaCl. B. F. KRAUS

535.375.5 : 548.7

7160. Second order Raman spectrum of the potassium chloride crystal. A. I. STEKHANOV. *J. Exp. Theor. Phys., USSR*, 20, 330-3 (April, 1950) In Russian.

An interpretation based on the elastic crystal spectrum calculated on Born's theory of the crystal lattice. The experimental findings, despite unfavourable conditions (a rather narrow slit and great dispersion of the spectrograph) showed an unmistakable continuous spectrum with very wide maxima of intensity. The steepest of these lies at 280 cm^{-1} , two others between 100 and 130 cm^{-1} and 179 – 216 cm^{-1} , respectively. Near the Rayleigh line of the KCl spectrum there is a continuous band of a width 58 cm^{-1} , very distinct on the microphotogram on the Stokes side, less so on the anti-Stokes side, owing to the preponderance of the $2\,534\text{ Å}$ Hg line. The width of the whole spectrum is about 450 cm^{-1} .

B. F. KRAUS

535.375.5.08

7161. Photoelectric method of investigating Raman spectra. M. M. SUSHCHINSKIĬ. *J. Exp. Theor. Phys., USSR*, 20, 304-17 (April, 1950) In Russian.

Full details are given of an apparatus using sensitive photo-multipliers and amplifiers. The Raman spectra presented and discussed by way of example are those of benzene and cyclohexane. The determination of the sensitivity and accuracy is given in full.

B. F. KRAUS

535.375.55 : 621.315.615

7162. Raman spectral analysis in insulation technology. T. WÖRNER. *Elektrotech. Z. [ETZ]* 71, 292-5 (May 22, 1950) In German.

The Raman effect is briefly explained. The application of the effect to insulation technology is discussed in connection with insulating oils with particular reference to their identification, determination of tendency to ageing, identification of ageing products, investigation of synthetic oils, waxes and impregnating media. Tabular information is given on group frequencies of the main components of various oils and the spectral lines for ageing products.

A. M. THOMAS

535.376

7163. The poisoning of cathodoluminescence in silver-activated cubic zinc sulfide. S. LARACH. *Letter in J. Chem. Phys.*, 18, 896 (June, 1950).

535.376

7164. Rise and decay of willemite luminescence. G. GERGELY. *J. Opt. Soc. Amer.*, 40, 356-61 (June, 1950).

The case of zinc silicate was studied at various excitation durations and intensities under cathode-ray

excitation. The observed decays were displayed on c.r. oscilloscope. Measurements were made with short pulses of 1 – $280\text{ }\mu\text{sec}$ separated by 20 msec and with square wave excitation. The pulse duration varied between $25\text{ }\mu\text{sec}$ – 10 msec . It was found that rise and decay curves could be separated into three components, which are strictly monomolecular, with time constants 200 , $1\,800$ and $72\,000/\text{sec}$. The duration of excitation does not influence the decay rates but varies the proportions of the individual components. The fast component is predominant at very short excitation times. Using longer excitations however, the slow component gives the most part of the light emission. The same components were found with periodical excitation too. It was found that the excitation intensity does not affect the decay rates. The brightness during the rise and decay was calculated for periodical excitation.

535.376 : 621.385.83

7165. Cathodoluminescence. G. F. J. GARLICK. *Adv. Electronics*, 2, 151-84 (1950).

A comprehensive review of work of the last ten years. Section headings: Classes of cathodoluminescent solids; Practical requirements. Experimental studies; Relation to electron energy and density; Rise and decay; Efficiency; Secondary electron emission; Fatigue and deterioration. Theoretical studies. Present trends of research. 53 refs.

535.41

7166. Interferometer for evaluation of directions. A. ARNULF AND M. CAGNET. *C.R. Acad. Sci., Paris* 230, 2014-15 (June 5, 1950) In French.

Use is made of 2 similar etalons which produce fringes of superposition when illuminated either with white or monochromatic light. If the incidence is 45° , then with white light a change in incidence in direction of only 0.12 second of arc produces a measurable fringe shift of $1/80$ th order. It is pointed out that the arrangement may have astrophysical applications, such as measurement of the separations of stellar doublets or of stellar diameters.

S. TOLANSKY

535.42

7167. A system of diffraction fringes with high contrast. A. KASTLER. *Rev. Opt. (Théor. Instrum.)*, 29, 307-14 (June, 1950) In French.

Two adjacent half-wave plates, with a straight dividing line, have their neutral axes at right angles. An incident plane wave has a $\lambda/2$ difference introduced in the two halves and after interference gives a system of fringes in the same position as those normally formed by the straight edge but with enhanced contrast. These fringes are symmetrical about a completely dark centre lying in the plane containing the line of division of the wave plates and the direction of the incident light. The intensity distribution is calculated as the sum of the squares of two Fresnel integrals, and is shown to agree with experimental values.

R. W. FISH

535.42

7168. The problem of the pupillary edge. P. M. DUFFIEUX. *Rev. Opt. (Théor. Instrum.)* 29, 323-39 (June, 1950) In French.

Schematic pupils used for the calculation of classical

raction effects are replaced by actual ones in which the edge with a curved profile is substituted by one with a rectangular section. The analysis describes the real edge in terms of 2 functions defining the profile and relating it to the differences between calculated and observed diffraction effects. The connection between 3-dimensional pupils and 2-dimensional diagrams representing them is discussed. Diagrams are given.

R. A. WEALE

535.42

69. The suppression of monochromatic diffraction edges by means of absorbing screens. B. DOSSIER, BOUGHON AND P. JACQUINOT. *J. Rech. Cent. Rech. Sci.* (No. 11) 49-69 (1950) *In French*.

Pupils making the suppression of diffraction edges possible are classified and solutions for a dimensional system given. The size of the source being taken into account the equations yield values for the light flux for a given size. Approximations derived which can be applied to numerical values. The characteristics of 2 families of screens are calculated, and the experimental arrangements for producing them described. Calculated and experimental values are compared. Figures, tables and numerous graphs are given.

R. A. WEALE

535.421

70. New form of phase diffraction grating. M. RYTOV AND I. L. FABELINSKII. *J. Exp. Theor. Phys., USSR*, 20, 340-1 (April, 1950) *In Russian*.

A reflection diffraction grating of a new type is described, which introduces in principle only a phase modulation into the reflected optical wave. Such a grating was made and used for a series of qualitative observations on the intensity distribution in diffraction spectra in natural and polarized light. A characteristic difference in the distribution of the intensities spectra in natural and polarized light was observed.

B. F. KRAUS

535.421 : 534.321.9

71. On the intensity distribution in the ultrasonic grating. F. PORRECA. *Nuovo Cim.*, 7, 171-3 (May, 1950) *In Italian*.

Microphotometric measurements of the intensity variations in the diffraction images produced by light passing through an ultrasonic diffraction grating in a $\text{b}(\text{NO}_3)_2$ solution give results in accordance with theory. [E. Hiedmann, "Ultraschallforschung" (1939)].

T. S. E. THOMAS

535.421 : 534.321.9

72. Diffraction of light by amplitude modulated ultrasonic beam. R. R. AGGARWAL, M. PANCHOLY AND S. PARTHASARATHY. *J. Sci. Industr. Res.*, 9B, 107-9 (May, 1950).

The diffraction pattern due to the oscillation of a quartz crystal excited by an amplitude-modulated wave has been theoretically explained on the basis of Raman-Nath elementary theory.

A.

535.421 : 534.321.9

73. Diffraction of light by ultrasonic waves. R. R. AGGARWAL. *J. Sci. Industr. Res.*, 9B, 110-14 (May, 1950).

The first 3 terms in the expression for the intensity of any order diffraction line have been calculated by

extending the results of the generalized theory of Raman and Nath. The experimental results on diffraction at oblique incidences, especially some of the special features, observed by various authors have been found in strict accordance with the theory.

A.

535.421 : 538.566

Diffraction pattern in a circular aperture measured in the microwave region. See Abstr. 7383

535.43

7174. Light scattering in the critical region. I. Ethylene. H. A. CATALDI AND H. G. DRICKAMER. *J. Chem. Phys.*, 18, 650-4 (May, 1950).

In the neighbourhood of the critical point, light scattering reveals the presence of 4 regions: (a) a region where the light scattering depends on the inverse 4th power of the wavelength; (b) a region of increasing scattering and decreasing dependence on wavelength, beginning about a degree above the critical temperature, and extending about a degree; the maximum scattering in this region is of the order of 100 times the initial value; (c) an abrupt decrease in scattering, accompanied by absorption which sets in at a higher temperature for the shorter wavelength; (d) a large and erratic increase in scattering, apparently resulting from condensation. The scattering observed upon cooling and heating are identical, provided the temperature does not drop below the temperature for zero scattering or condensation. The wavelength dependence of light scattering is not completely described by any existing theory. Applying the Ornstein-Zernike equation where it is possible, clusters of about 20 molecular diameters are calculated more than a degree above the critical temperature. These clusters increase rapidly with decreasing temperature.

A.

535.43

7175. Light scattering in the critical region. II. Ethane. A. L. BABB AND H. G. DRICKAMER. *J. Chem. Phys.*, 18, 655-6 (May, 1950).

Light scattering experiments have been performed on ethane in the critical region, using apparatus and procedure previously applied to ethylene. The results are qualitatively quite similar to those obtained for ethylene, indicating that no theory so far developed completely describes the phenomenon.

A.

535.436 : 539.133

7176. Scattering of light by anisotropic gas molecules. A. HAMMAD. *Proc. Math. Phys. Soc. Egypt*, 4, 3-14 (May, 1949).

The scattering of light by a number of anisotropic gas molecules is considered, and expressions are given for the intensity and polarization of the scattered light. A method is indicated for measuring the "coefficient of molecular anisotropy."

A.

535.55

7177. Measuring fringe orders in photoelasticity. W. A. P. FISHER. *Research, Lond.*, 3, 298-303 (July, 1950).

After an introduction in which such terms as Material unit fringe value and Model fringe value are defined, a review is made of methods of measurement which are, as far as possible, independent of personal judgment. The methods employed are either

measurement by fringe count or by compensation. The former is used with highly sensitive materials. Reference is made to the compensators of Coker, Babinet and Berek. A method of compensation due to Tardy [*Rev. Opt. (Théor. Instrum.)* 8, 59 (1929)] which can be more accurate than methods using the above-mentioned compensators is described. It uses rotation of the analyser for compensation. Mention is made of a photoelectric method due to Brown and Hickson [Abstr. 3101 (1950)] which possesses high accuracy.

H. G. JERRARD

535.56

7178. Theory of the natural optical activity. M. V. VOLKENSHTEIN. *J. Exp. Theor. Phys., USSR*, 20, 342-6 (April, 1950) In Russian.

Two errors in Born's theory are removed, and expressions for dipole polarization and magnetization correctly derived, giving a value for the rotatory power agreeing with experimental values. The expressions are suitable for cases of a weak anisotropy, where the difference in the direction of E and E' may be neglected, e.g. optically active gases or solutions in an electric field.

B. F. KRAUS

535.56 : 541.65

Optical activity: its study, terminology and uses. See Abstr. 7579

535.651

7179. A description of a new method for the calibration of objective tricolorimeters. B. BUCHMANN-OLSEN. *Trans. Danish Acad. Tech. Sci. (No. 6)* 11 pp. (1948).

A time-saving method is described in which the only spectro-photometric measurements consist in the determination of the reflection factors of 3 surface colours. These can be related to the tristimulus values of the CIE standard observer. The experimental arrangement is described, and a table shows that the results obtained by spectro-photometry and by the new method agree to within the experimental error.

R. A. WEALE

535.651 : 621.385.832 : 621.317.39

7180. Measuring color of cathode-ray screens. A. E. MARTIN AND S. N. ROBERTO. *Electronics*, 23, 108-10 (Feb., 1950).

A spectroradiometer for rapid tests on television c.r.t.s is described. Light radiated from a standard 525-line raster on a c.r.t. screen is admitted through a slit to a quartz monochromator. A cam drive rotates the prism so that equal wavelength intervals of the spectrum move past the exit slit in equal time intervals, covering the range 7200-3600 Å. The light is picked up by a photo-multiplier tube which is connected to an a.c. amplifier and chart recorder. Calibration is effected by directing reflected light from a tungsten filament projection lamp through the monochromator and a 60 c/s light chopper on to the same photo-multiplier. Continuous and reversible rotation of the wavelength drive is possible, giving slow or fast scans in either 12 min or 48 sec. Coarse and fine adjustments are effected by gain control of the amplifier using additional cams. All power supplies are regulated and current feedback is used in all the amplifier stages. A c.r.o. connected to the

amplifier output permits examination of build-up and decay characteristics of phosphors.

H. G. M. SPRATT (R)

535.68

7181. The colors of distant objects. W. E. K. MIDDLETON. *J. Opt. Soc. Amer.*, 40, 373-6 (June, 1950).

A general expression is developed for the apparent colour of an object of any intrinsic colour, seen through a given thickness of an atmosphere of any specified optical properties. In deriving this expression, the author has made use of modern theories of the alteration of contrast by the atmosphere. Some examples of the application of this theory are given, and in conclusion it is shown that the visual range of coloured objects differs little from that of achromatic objects of the same luminance factor.

535.89

7182. A new laboratory hydrogen continuum. S. K. BHATTACHARYA. *Indian J. Phys.*, 24, 109-10 (March, 1950).

A simple high intensity H discharge tube as a source for ultraviolet light is described. This H continuum source is very simple and easy to set up in any laboratory.

HEAT 536

536.21

7183. Heat conduction by powders in various gaseous atmospheres at low pressure. J. A. PRINS, J. SCHENK AND A. J. G. L. SCHRAM. *Physica*, 16, 379-80 (April, 1950).

536.21

7184. The thermal conductivity of soils. A. GEMANT. *J. Appl. Phys.*, 21, 750-2 (Aug., 1950).

The thermal conductivity of soils of varying moisture content is calculated on a physical basis. The results of this computation are, in a range of moisture contents from 5 to 25%, in agreement with experimental data in the literature. The influence of soil composition on conductivity is also explained by the theory. The use for practical purposes of an average resistivity value of 60 to 70 thermal ohms appears justified in the light of this analysis.

536.21 : 548 : 536.48

7185. The thermal conductivity of potassium chrome alum at temperatures below one degree absolute. C. G. B. GARRETT. *Phil. Mag.*, 41, 621-30 (July, 1950).

From measurements made between 0.14° and 0.30°K, it is concluded that the mean free path of the phonons in the crystal is about $\frac{1}{2}$ mm. In the method employed, a long single crystal of the salt, isolated from the outside world, is demagnetized to a uniform low temperature, a temperature gradient along the crystal is then set up, and the time constant of the subsequent heat flow measured. The paper concludes with a consideration of the lowest temperature to which a sample of material could in a reasonable time be cooled by direct thermal contact with a cold mass of paramagnetic salt.

536.212.2 : 621.316.923

71. On the melting time of fuses. E. WINTER-
R. *Z. angew. Phys.*, 2, 167-74 (April, 1950) In
German.

A comprehensive theoretical discussion of the
dependence of the melting time, t , on the heat loss
rate, and physical properties of, a fuse wire. The
various methods of heat removal for a wire in a gas
and embedded in a solid are separately considered, and
approximate values are derived in the general case
of the limiting current, i.e. the current for which
 $t \rightarrow \infty$, and for t . A silver wire is considered in
particular and the theoretical and experimental
results agree well.

S. WEINTROUB (R)

536.212.2 : 621.316.923

72. On a solution of the heat conduction equation
which enters into the theory of electrical fuses. G. U.
STUBERT. *Z. angew. Phys.*, 2, 174-9 (April, 1950)
German.

An infinitely long straight wire of circular cross-
section is embedded in an insulator of infinite extent.
At a given instant a constant wattage is applied and
maintained. The equation for the heat conduction
in the insulator is treated mathematically using the
Laplace transform. The general solution can be
represented only in an integral form, but series
representations for the space-time temp. field at the
commencement of heating and after the lapse of a
long time are obtained. For complete adiabatic
conditions the temp. rise in the wire would be a
linear function of time, but due to the heat conduction
in the insulator this temp. rise is retarded. For long
periods of heating the temp. increases logarithmically.
See also preceding Abstr.].

S. WEINTROUB

536.24

73. An experiment on the heated plate. T.
SUWAHARA. *J. Soc. Appl. Mech. Japan*, 3 (No. 15)
1-51 (1950) In Japanese.

The author states here some results on the measure-
ment of the relative wind velocity and temperature
distribution in the boundary layer on the heated plate,
and it is found that there is probably a thin layer of
convection just on the plate, when the temperature
gradient becomes larger.

A.

536.24 : 533.6.011.311

74. Contributions to the theory of heat transfer
through a laminar boundary layer. M. J. LIGHTHILL.
Proc. Roy. Soc. A, 202, 359-77 (Aug. 7, 1950).

An approximation to the heat transfer rate across
a laminar incompressible boundary layer, for arbitrary
distribution of main stream velocity and of wall
temperature, is obtained by using the energy equation
in von Mises's form, and approximating the coefficients
in a manner which is most closely correct near the
surface. By known transformations an expression is
deduced for heat transfer to a surface, with arbitrary
temperature distribution along it, and with a uniform
stream outside it at arbitrary Mach number. From
this, the temperature distribution along such a surface
is deduced in the case (of importance at high Mach
numbers) when heat transfer to it is balanced entirely
by radiation from it. This calculation gives higher

temperatures near the nose, and lower ones farther
back, than are found from a theory which assumes
the wall temperature uniform and averages the heat
transfer balance. The author is not in a position to
say whether or not the effect will be appreciable for
metal projectiles, but for stony meteorites at a certain
stage of their flight through the atmosphere it indi-
cates that melting at the nose and re-solidification
farther back may occur, for which the shape and
constitution of a few of them affords evidence.

A.

536.24 : 535.231.4

7190. Comparative heat losses from bare and
anodized aluminum surfaces to still air. A. C. BURR
AND R. H. HAY. *Canad. J. Res.*, A, 28, 281-6 (May,
1950).

The effect of anodic films on the total heat losses
to still air from the surfaces of cylindrical Al con-
tainers maintained at temperatures between 23°C
and 100°C has been studied by recording the power
required to maintain the containers at various
temperatures above ambient. Anodic coats of the
order of 20 μ thick required increases in power of
43% to 60% at 30°C and 68% to 79% at 90°C, the
variations at any one temperature being due to
variations in thickness and colour of the coating.
The emissivity coefficient for the clear anodic coats
used is estimated from the data to be about 0.80.

A.

536.24 : 551.578.11

7191. A note on the thermal inertia of cloud particles.
B. K. AGARWALA AND N. K. SAHA. *Indian J. Phys.*,
24, 57-60 (Feb., 1950).

The thermal lag of small liquid droplets losing heat
to the surroundings by the processes of convection
and radiation is calculated, being defined as the time
required by the initial (small) temperature difference
between the drop and the surroundings to be reduced
to $1/e$ of its value. The results seem to be of some
application to meteorology in explaining the forma-
tion of an average rain drop from droplets. The
thermal lag being a function of the radius of the drop,
a temperature difference will exist between larger and
smaller droplets in any cloud layer. On account of
this temperature difference the cooler drops will grow
at the expense of the warmer ones.

A.

536.3 : 535.312

7192. Thermal radiation from partially transparent
reflecting bodies. H. O. MCMAHON. *J. Opt. Soc.
Amer.*, 40, 376-80 (June, 1950).

The emissivity, transmissivity and reflectivity are
considered in detail for heated, reflecting, partially
transparent bodies. Kirchhoff's law, which in its
usual form applies only to opaque bodies, is generalized
to apply to matter of all kinds. An exact solution is
found for the relationships between the "apparent
reflectivity," R^* , and the true reflectivity and true
transmissivity. Similarly, the "apparent trans-
missivity," T^* , is expressed as a function of the true
transmissivity and true reflectivity. Further develop-
ment of these considerations makes it possible to
construct a ternary chart in which the observables
 E , T^* and R^* are plotted at the apices of a triangle,
the true transmissivities and reflectivities then appear
as a system of intersecting lines on the chart.

A.

536.421.1 : 548.536

7193. On the influence of atomic or molecular volume on the form of the melting-point minima for a series of binary mixed crystals. T. HEUMANN. *Z. Naturforsch.*, **5a**, 216-28 (April, 1950) In German.

Calorimetric investigation of several binary systems. One of many conclusions is that a relative volume difference of more than 33% prevents the formation of ideal mixed crystals. J. R. MADDOX

536.421.4

7194. Microscopic observation of the solidification of small metal droplets. D. TURNBULL AND R. E. CECHE. *J. Appl. Phys.*, **21**, 804-10 (Aug., 1950).

The solidification behaviour of small metal (10 to 100 micron diameter) droplets has been observed on a high temperature microscope stage. An abrupt change in surface appearance and in the case of high melting metals a sudden brightening ("blick") accompanies solidification. The solidification temperatures observed for a collection of droplets may be widely distributed, but a significant, usually the major, fraction of the droplets supercool some maximum amount $(\Delta T)_{\max}$ that is reproducible and characteristic of the metal. For many metals $(\Delta T)_{\max} \approx 0.18 \times$ the absolute melting temperature. $(\Delta T)_{\max}$ is not much changed by wide variations in the cooling rate and droplet size. The growth rate of metal crystals is very great so that the solidification rate of the droplets is controlled by the nucleation frequency. A.

536.423 : 539.23

7195. The influence of concentration-dependent diffusion on rate of evaporation. J. CRANK. *Proc. Phys. Soc., Lond., B*, **63**, 484-91 (July, 1950).

It has been suggested that evaporation through a membrane or from a polymer film has a characteristic behaviour different from that commonly associated with a free liquid surface. In particular it is claimed that an increase in surface humidity produces an increased rate of evaporation through a membrane, though the opposite effect is well known for a liquid surface. This behaviour is said to be observed when diffusion within the membrane or film is the rate controlling process in systems for which the diffusion coefficient increases with increasing concentration. In this paper the behaviour of such diffusion-controlled evaporation processes is examined from the point of view of the diffusion equations and it is found that there is no theoretical reason to expect such processes to show anomalous behaviour. It is seen that when the experimental data for evaporation through a membrane are correctly interpreted they are in agreement with theoretical prediction. The so-called "skin effect" in the dry spinning of fibres is examined and appears to be due to complicating features other than diffusion. A.

536.423.15

7196. The vapor pressure of plutonium halides. T. E. PHIPPS, G. W. SEARS, R. L. SEIFERT AND O. C. SIMPSON. *J. Chem. Phys.*, **18**, 713-23 (May, 1950).

Vapour pressure measurements have been made with three halides of Pu by a modification of the Knudsen effusion method. Measurements with solid PuF_3 from 1200°K to 1400°K give the vapour-

pressure/temperature relation $\log_{10} p_{\text{mm}} = 12.468 - 21120/T$. Measurements with liquid PuF_3 from 1440°K to 1770°K give $\log_{10} p_{\text{mm}} = 11.273 - 19400/T$. Measurements with solid PuCl_3 from 850°K to 1007°K give $\log_{10} p_{\text{mm}} = 12.726 - 15910/T$; with liquid trichloride from 1007°K to 1250°K give $\log_{10} p_{\text{mm}} = 9.509 - 12590/T$. Measurements with solid PuBr_3 from 800°K to 929°K give $\log_{10} p_{\text{mm}} = 13.386 - 15280/T$; with liquid tribromide from 929°K to 1100°K give $\log_{10} p_{\text{mm}} = 10.321 - 12360/T$.

536.423.15

7197. The volatility of plutonium dioxide. T. E. PHIPPS, G. W. SEARS AND O. C. SIMPSON. *J. Chem. Phys.*, **18**, 724-34 (May, 1950).

The volatility of PuO_2 has been measured in the temperature range 1320°C to 1790°C by a modification of the Knudsen effusion method. The PuO_2 was heated in vacuum in a tantalum oven. Under these conditions the dioxide was reduced to a lower oxide, or oxides, which maintained a constant reproducible vapour pressure throughout further heating. Either an oxide was formed which was stable under the conditions of the experiment or thermal reduction continued with the formation of a second solid on liquid phase. The thermal reduction of the oxide was reversed by heating the reduced oxide in a low pressure atmosphere of O.

536.46

7198. The wall-quenching of laminar propane flames as a function of pressure, temperature, and air-fuel ratio. R. FRIEDMAN AND W. C. JOHNSTON. *J. Appl. Phys.*, **21**, 791-5 (Aug., 1950).

The quenching distance between plane-parallel plates has been measured for propane-air flames at eight pressures ranging from 0.0832 to 2.77 atmos. and air-propane ratios ranging from 11 to 24. Other tests have been made at atmospheric pressure in which (a) the temperature of the quenching plates has been varied from 80° to 715°F, (b) the temperatures of both of the inlet gas and the quenching plates have been varied from 80° to 545°F, and (c) a series of six different solid surfaces was tested. The minimum quenching distance is found to occur at an air-propane ratio between 13.5 and 14.0, and $\propto (\text{pressure})^{-0.91}$. Lean mixtures are found to be slightly less pressure-sensitive. When both the inlet gas and plates are heated, the minimum quenching distance is found to $\propto 1/\sqrt{(\text{abs. temp.})}$. The quenching effect appears to be independent of the nature of the surface. A.

536.46 : 535.33.03

7199. Excitation of spectra in the inner cones of flames. A. G. GAYDON AND H. G. WOLFARD. *Proc. Phys. Soc., Lond., A*, **63**, 778-80 (July, 1950).

In the inner cones of many flames there is abnormally high electronic excitation. In the reaction zones of low-pressure flames spectrum-line reversal measurements using lines of Fe, Pb or Tl give very high temperatures, especially for lines of short wavelength. Lines of Fe requiring up to at least 174 kcal/mole are excited. The effect occurs for flames of C_2H_2 , C_2H_6 , CH_4 and CH_3OH , but not for H_2 , CO or HCHO. A. G. GAYDON

- 536.463 : 541.126
10. A study of combustion. The mechanism of combustion from the viewpoint of the vibration observed in the burning system of H_2-O_2 . T. ICHIKAWA, NAKANO AND H. YAMAMURA. *J. Sci. Hiroshima Univ. A*, **14**, 76-83 (July, 1949).
- H_2-O_2 mixtures were exploded in long glass tubes; mixture was ignited by an electric spark near one end of the tube and the pressure-variation at the other end of the tube was measured by a piezoelectric gauge. Three types of tube were used, each 1 cm dia., but varying in length from 26.0 to 50.5 cm. The composition of the gas-mixture covered the range 10% to 90% H_2 (approx.); the initial gas-pressure was 1 atm. (approx. 200 mm Hg). Three types of pressure-variation are distinguished: (a) non-vibrational, in which the pressure rises and falls gradually, without oscillation; (b) vibrational, in which the pressure rise and fall is fairly gradual, but is accompanied by a prolonged sinusoidal oscillation; (c) impulsive, in which the pressure rises abruptly, sometimes with periodic oscillations. Conditions for the occurrence of these 3 types of pressure variation were investigated and are described. It was found that the period of the oscillations of type (b) is approx. equal to the time taken for a detonation wave to travel twice along the reaction tube.
 A. SCHOFIELD
- 536.468
11. The composition limit of flame-propagation of combustible gaseous mixtures. I. (H_2-O_2 system). T. ICHIKAWA AND H. YAMAMURA. *J. Sci. Hiroshima Univ. A*, **14**, 73-5 (July, 1949).
- To achieve regularity in initiation a detonation wave of a standard mixture was used as the igniting source. The experiments were carried out at a pressure of 10 mm Hg in a tube 1 cm dia., which was divided into 3 sections AB, BC and CD by Hg breaks at A and C. The sections AB and CD were filled with stoichiometric mixture of H_2 and O_2 , while BC contained the mixture under examination. At the instant when the 3 sections were connected by lowering the Hg level at B and C, an electric spark initiated a detonation wave in AB. Passage of a flame in the first-section BC was indicated by an ionization gap at D. It was found that the lower limit of flame propagation in H_2-O_2 mixtures is at 20% H_2 and that this limit is independent of the length BC; the upper limit varies linearly with the length BC, from 80% H_2 when BC = 390 cm to 93% H_2 when BC = 100 cm.
 A. SCHOFIELD
- 536.48
12. Non-equilibrium thermodynamics and Gorter's model of liquid helium II. S. R. DE GROOT, L. JANSEN AND P. MAZUR. Letter in *Physica*, **16**, 421-2 (April, 1950).
- 536.48
13. A metal dewar for liquid helium. W. E. HENRY AND R. L. DOLECEK. *Rev. Sci. Instrum.*, **21**, 96-7 (May, 1950).
- 536.48
14. The lambda-temperature in multimolecular helium films. S. V. R. MASTRANGELO. Letter in *Chem. Phys.*, **18**, 896-7 (June, 1950).
- 536.48
7205. Helium II transfer on metal surfaces. K. MENDELSSOHN AND G. K. WHITE. Letter in *Nature, Lond.*, **166**, 27-8 (July 1, 1950).
- 536.52 : 536.462 : 535.231
7206. Optical method of measuring the temperature of an enclosed technical flame. N. N. SOBOLEV AND T. I. SHCHETININ. *J. Exp. Theor. Phys., USSR*, **20**, 356-70 (April, 1950) *In Russian*.
- It was found that the continuous spectrum of the radiation of a technical flame (combustion of kerosene in an air current) extends over the whole visible range. For the visible range, the absorption of the flame is independent of the wavelength. The energy distribution in the emission spectrum obeys Wien's law of the grey radiator. This was taken as the basis for developing a method of determining the temperature by measuring the energy distribution in the emission spectrum of the flame. The new method was then compared with the method based on the formation of the spectral lines. The results were in mutual agreement.
 B. F. KRAUS
- 536.521 : 536.462
7207. Optical determination of the true temperature of luminous flames. F. RÖSSLER. *Z. angew. Phys.*, **2**, 161-6 (April, 1950) *In German*.
- The effect of light-absorption by C particles on the optical pyrometry of luminous flames is discussed. Both the black-body temp. T_b and the colour temp. T_c of such flames differ from the true temp. T ; for thin flames the error may be as much as 20%. The black-body temp. T_b is less than T because the absorptivity (and hence emissivity) is less than unity; the colour temp. T_c is greater than T because the absorptivity depends upon wavelength, being higher in the blue than in the red. Assuming that the absorption coeff. is known as a function of wavelength, relations between T_b , T_c and T are derived. These relations may be used to correct observed values of T_b and T_c . The method is illustrated by an estimation of the true flame temp. of the Hefner lamp. Although the observed T_b is more than 10% low, and the observed T_c more than 10% high, the corrected values of T_b and T_c agree with each other, and with the directly measured true temp. T , to better than 1%.
 A. SCHOFIELD
- 536.53
7208. Methods of increasing the sensitivity of thermopiles. P. BARCHEWITZ AND J. TURCK. *J. Phys. Radium*, **11**, 288-90 (June, 1950) *In French*.
- Theory indicates that the sensitivity of a thermocouple may be increased by working it at low temperature and *in vacuo*. Increments by a factor of order 20 were obtained experimentally.
 P. M. DAVIDSON
- 536.531
7209. Production and calibration of a group of resistance thermometers with quartz frames. N. A. BRILLYANTOV, V. I. LINKOV AND P. G. STRELKOV. *J. Tech. Phys., USSR*, **20**, 335-44 (March, 1950) *In Russian*.

536.531

7210. A note on the use of resistance thermometers for measurement of rapidly changing temperatures. C. B. DAISH, D. H. FENDER AND A. J. WOODALL. Letter in *Phil. Mag.*, **41**, 729-30 (July, 1950).

536.532

7211. The e.m.f.-temperature calibration of platinum, 10% rhodium-platinum and platinum, 13% rhodium-platinum thermocouples over the temperature range 0°-1760°C. C. R. BARBER. *Proc. Phys. Soc., Lond., B*, **63**, 492-503 (July, 1950).

Tables are given which are based on the calibration of 12 thermocouples of each kind, 6 from each of 2 manufacturers. Each set of 6 thermocouples comprised 2 samples from each of 3 batches of wire. The calibrations are in terms of the International Temperature Scale as revised at the Ninth General Conference of Weights and Measures held in Paris in October 1948. The methods of intercomparison between the thermocouples and the various interpolation instruments specified in the International Temperature Scale are described. It is shown that the difference between the new tables and the old are mainly due to changes in the International Temperature Scale, and that the new tables represent the shape of the e.m.f.-temperature characteristics of the thermocouples of either make sufficiently closely to give interpolation between calibration points with accuracy within $\pm 1^\circ\text{C}$ up to 1063°C , $\pm 2^\circ\text{C}$ up to 1550°C and $\pm 3^\circ\text{C}$ above this temperature. A.

536.629 : 533.5

Vacuum differential thermal analysis. See Abstr. 7063

536.631

7212. The specific heats of MgO , TiO_2 , and ZrO_2 at high temperatures. J. S. ARTHUR. *J. Appl. Phys.*, **21**, 732-3 (Aug., 1950).

Mean specific heats were determined from 20°C to 800°C . True specific heats were then calculated assuming that $C_T = A + BT + CT^2$. At 350°C the true specific heats were calculated to be: MgO , 0.276 ; TiO_2 , 0.210 ; ZrO_2 , 0.140 . A.

536.655

7213. The temperature function of the internal heat of evaporation. J. C. DE WIJS. *J. Phys. Coll. Chem.*, **54**, 599-601 (May, 1950).

An empirical formula for the internal heat of evaporation as a function of the temperature is given. This relation is valid between the melting point and the critical temperature of the substance. A.

536.655 : 536.71

7214. Relation between the molecular heat of vaporization and surface tension of liquids. J. F. JOLIET. *C.R. Acad. Sci., Paris*, **230**, 2006-8 (June 5, 1950) In French.

A relationship between the surface tension, λ , and latent heat, L , is given in the form $\lambda = (L - RT)/(NvV)^{1/2}$, where v and V are the molecular volumes in the gaseous and liquid states and N Avogadro's constant. The calculated and experimental values of λ are tabulated at the normal b.p. for 20 substances and show good agreement. It is claimed that the temperature variation is also well

represented, but for abnormal liquids (alcohols) the calculated values are stated to be higher than the experimental values but the curves of temperature variation are parallel. Further, for an homologous series at a given temperature the ratio (λ calc./ λ exp.) appears constant.

F. E. HOARE

536.656 : 548.3

7215. Evolution of heat during disorder-order transformation in AuCu. G. BORELIUS, L. E. LARSSON AND H. SELBERG. *Ark. Fys.*, **2**, Paper 17, 161-70 (1950).

A specimen of alloy surrounded by a large Al block, maintained at different temperatures between 360°C and 400°C , was heated above the transition temperature and allowed to cool. Thermocouples measured the difference in temperature between the specimen and the environment. The total heat of transformation is calculated from the cooling curves. The results agree with nearest-neighbour theory and a constant-rate-of-nucleation hypothesis suggests that ordered domains grow 3-dimensionally.

J. R. MADDON

536.660

7216. Heat of atomization of carbon. H. DI SPRINGALL. *Research, Lond.*, **3**, 260-7 (June, 1950).

Indirect (spectroscopic evidence, photodissociation, electron impact dissociation, thermochemical, and kinetic) and direct (sublimation) methods of evaluating the heat of atomization of C are discussed. No single value of L is acceptable so far. It is suggested that the order of the relative probabilities of the 4 possible values is: prob. $(170.4 \text{ k/a}) >$ prob. $(136.1 \text{ k/a}) >$ prob. $(141.2 \text{ k/a}) >$ prob. (125.0 k/a) , k/a standing for kcal/g atom. The recent paper by McDowell and Warren [*Inst. Petroleum, Mass. Spectrometry Symposium* (April, 1950), Paper 4] seems to indicate that $L \leq 140 \text{ k/a}$. F. LACHMAN.

536.667

7217. Calculation of the heats of formation of alkali halide solid solutions from Hildebrand's equation. M. FINEMAN. Letter in *J. Chem. Phys.*, **18**, 771-2 (May, 1950).

THERMODYNAMICS 536.7/8

536.7 : 530.162

7218. Thermodynamics and the canonical distribution. R. EISENSCHITZ. *J. Chem. Phys.*, **18**, 858-60 (June, 1950).

The hypothesis is made that the thermodynamic energy and the virtual work done in a reversible process are statistical averages of the corresponding mechanical quantities and that the averages comply with the laws of thermodynamics. These assumptions are shown to be sufficient for deriving the canonical distribution so far as the distribution on the energy scale is concerned. A.

536.7 : 541.183

Thermodynamics of adsorption. See Abstr. 7573

536.73 : 530.145.6 : 530.162

The second law of thermodynamics deduced from the quantum theory. See Abstr. 7029

720. The thermodynamic properties of sulfur dioxide. J. R. WEST AND G. P. GIUSTI. *J. Phys. Chem.*, **54**, 601-5 (May, 1950).
In the literature the thermodynamic properties of sulfur now extend from -100° to 500°F and from 0.294 to 1000 p.s.i.a. Data to 2000°F are given in this paper. A.

536.753

721. The entropy of the chloride ion at 12.5°C . D. CROCKFORD AND J. L. HALL. *J. Phys. Coll. Chem.*, **54**, 731-4 (May, 1950).
The absolute entropy of the Cl ion in 6 different concentrations of HCl, NH_4Cl , NaCl and KCl at a temperature of 12.5°C has been calculated from data obtained from thermocells, using silver-silver chloride electrodes. A.

ELECTRICITY 537

THEORY . ELECTRONS 537.1

722. Annihilation of positrons in gases. A. ORE. *Bergens Museums Arb.* (No. 9) 15 pp. (1949).
Various aspects of the phenomenon of dematerialization of positrons in gases are discussed together with the feasibility of basing a calculation of the life times of the positrons on Dirac's formula for the cross-section for free-particle annihilation. The conclusion is reached that no very accurate values can be predicted in this way. The case of the annihilating gas being He is considered in some detail. In the course of the discussion one is led to a natural way in which to improve the theoretical results obtained by Coulson and Duncanson for the dissociation energy of the ion HeH^+ . A.

ELECTROSTATICS . DIELECTRICS 537.2

722. Problem of the electrometric measurement of the Volta effect. N. T. KASHUKEEV. *C.R. Acad. Bulg. Sci.*, **2**, 41-4 (April-June and Oct.-Dec., 1949) in Russian.

The classical formula and method for measuring contact potential differences was developed by Hallwachs in 1885, improvements and refinements being due to Orlich, 1903, Schultze, 1908, Nadjakov, 1947, and Khristov, 1948. Two new methods are suggested by the author, based on an electrometric formula of Moulin, 1907, suitably transformed and presented in the form of a calibrating curve. The accuracy of the measurements was confirmed by comparing the two methods with each other and with H-meter measurements. It is very likely to be efficient for contact potential measurements not only between different metals, but also in systems

metal-semiconductor and metal-electrolyte, respectively. B. F. KRAUS

537.221 : 541.182.3

7223. The static electrification of dust particles on dispersion into a cloud. W. B. KUNKEL. *J. Appl. Phys.*, **21**, 820-32 (Aug., 1950).

An extensive study of the charge and size distribution of particles from 0.5 to 30 microns radius in dust clouds of various types dispersed in air under a variety of conditions ranging from blowing with minimum of turbulence to conditions of violent and maximum impact with various types of surfaces was made using adaptations of the Hopper and Laby modification of the oil drop experiment. It was observed that all dusts, including homogeneous dusts with no impacts on solid surfaces, were charged. In homogeneous systems the charges of opposite sign were equal, no net charge resulting, the number of particles of similar size with opposite charges being about the same. The magnitude of charges increased somewhat less rapidly than the surface of the particle. There was no correlation between size and sign of charge. There is strong evidence that charging occurs on separation of the contacts between particles in the dispersion of the cloud. Humidity did not affect the charging. Studies of heterogeneous systems making contact with solid walls of different composition from the powder gave consistent asymmetry of charge of varying degrees depending on the proportion of particles striking the surfaces relative to those just separated. A.

537.221 : 541.182.3

7224. Charge distribution in coarse aerosols as a function of time. W. B. KUNKEL. *J. Appl. Phys.*, **21**, 833-7 (Aug., 1950).

The interaction of small particles suspended in air with the ions normally produced in the air is discussed. The neutralization of highly charged dust particles, if suspended in air, is treated in detail. The result is found to be in qualitative agreement with experiment. The special case of final equilibrium is investigated. It is found that multiply-charged particles should be present in appreciable number in coarse aerosols at all times. This is confirmed by experiments both for initially charged quartz dust and for initially neutral ammonium chloride smoke. The general nature of an equilibrium charge distribution is presented. Charges up to ten electron units are found to be not uncommon. A.

537.221 : 621.385

7225. Variations of grid contact potential and associated grid currents. H. B. MICHAELSON. *J. Franklin Inst.*, **249**, 455-73 (June, 1950).

A survey, serving as a guide to the literature on grid contact potentials and the associated grid currents. The appendices list thermionic work functions for 44 pure metals, for contaminated metals, and for oxides. A.

537.226.2

7226. Dielectric strength of titanates of metals of the second group of Mendeleev's table. B. M. VUL, I. M. GOLDMAN AND R. YA. RAZBASH. *J. Exp. Theor. Phys.*, USSR, **20**, 465-70 (May, 1950) in Russian.

The dielectric strength of the metatitanates of the

metals of the second group is relatively low and does not depend much on the state. That of Ba titanate is the lowest of all. The measurements on Ba titanate also revealed that the dielectric strength in this case is nearly independent of changes of the dielectric constant, even considerable ones.

B. F. KRAUS

537.226.2

7227. The electrical properties of titanium dioxide. YA. M. KSENDZOV. *J. Tech. Phys., USSR*, **20**, 117-28 (Jan., 1950) *In Russian*.

The electrical properties of TiO_2 were shown to depend essentially on the purity of the product, which in the "technical TiO_2 " leaves much to be desired and is very difficult to achieve. The parallel investigation of the pure and technical modification (which has rutile character) showed that the pure product has an abnormally high d.c. (about 93) and a dielectric loss figure which greatly depends on temperature and frequency. When annealed in a weakly or heavily oxidizing atmosphere, TiO_2 takes an O-excess. The polycrystalline product obtained consists of large crystallites, embedded in an inter-crystalline layer. There are reasons for assuming an irregular distribution of the O and this accounts for the remarkable and complex dielectric properties. Agreement between calculations and experimental results is satisfactory.

B. F. KRAUS

537.226.2

7228. Seignette-electric characteristics of some titanates and zirconates of divalent metals of Perovskite-type structure. G. A. SMOLENSKIĬ. *J. Tech. Phys., USSR*, **20**, 137-48 (Feb., 1950) *In Russian*.

The dielectric permittivity of cadmium and lead titanate, lead zirconate and of the solid solutions $(\text{Ca,Pb})\text{TiO}_3$ and $(\text{Sr,Pb})\text{TiO}_3$ was investigated and all these compounds were found to be ferro-electrics. Their Curie temperature is in a considerable measure determined by the degree of the co-valency character of the lattice bond and by the dimensions of the oxygen octaeder containing the Ti-ion. It was also found that the lattice of these ferro-electrics is of the tetragonal type below the Curie point.

B. F. KRAUS

537.226.2

7229. Variation of dielectric constant with concentration. B. R. YATHIRAJA IYENGAR. Letter in *Curr. Sci.*, **19**, 150 (May, 1950).

537.226.3

7230. Dielectric properties of the uranium oxides, UO_2 , U_3O_8 and UO_3 . M. FREYMANN AND R. FREYMANN. *C.R. Acad. Sci., Paris*, **230**, 2094-6 (June 12, 1950) *In French*.

Dielectric loss measurements from 1 to 16 kc/s and 0 to -150°C show:— UO_2 to have a large loss of electronic origin falling rapidly with temperature below -100°C ; U_3O_8 to have a Debye loss region with a peak, $\epsilon'' \sim 5$ at 16 kc/s and -70°C , which moves to lower frequencies at lower temperatures and to have a larger loss at 0°C ; UO_3 to be entirely without loss.

D. H. WHIFFEN

ELECTRIC CONDUCTION . CURRENTS 537.33

537.311.1 : 621.385.1.032.216 : 621.315.592.4

7231. Conduction processes in the oxide-coated cathode. R. LOOSJES AND H. J. VINK. *Philips Tech. Rev.*, **11**, 271-8 (March, 1950).

A description of the methods of preparing and activating an oxide-coated cathode, from which it appears that the carbonate coating originally applied has to be subjected to such a heating process as to result in a loosely sintered, porous oxide coating. The electrons emitted from the coating have to be restored by conduction through the oxide coating. It is shown to be probable that the conduction of the oxide coating is due to two mechanisms acting in parallel: the electronic conduction of the grains, predominating at low temperatures ($< 800^\circ\text{K}$), and the conduction through the electron gas in the pores between the grains, which is preponderant at high temperatures ($> 800^\circ\text{K}$). With the aid of the conduction through the pores it can also be seen why the I - V characteristic for h.v. curves towards the V -axis. The fact that at the highest temperatures ($> 1000^\circ\text{K}$) the conduction lags behind the emission, as also the fact that in this temperature range the curvature of the I - V characteristic disappears, can be explained by taking into account the effect of the space charge upon the electron density and upon the field in the pores.

A.

537.311.23 : 548.0

7232. Conductivity and thermo-electric power of selenium single crystals. K. W. PLESSNER. Letter in *Nature, Lond.*, **165**, 970-1 (June 17, 1950).

537.311.3

7233. The effect of occluded hydrogen on the electrical resistance of palladium. P. WRIGHT. *Proc. Phys. Soc., Lond. A*, **63**, 727-39 (July, 1950).

Agreement between the results of theoretical and experimental investigations of the absorption of H by Pd indicates that, at least at higher temperatures, the H is contained in solid solution. Apparatus for observing the changes in electrical resistance of Pd during absorption and evolution of H is described, with which resistance-pressure isotherms from 75° to 150°C were obtained for pressures increasing and decreasing between zero and atmospheric. Factors affecting the resistance of the Pd-H system are discussed and an explanation of the form of the isotherms is given; a decrease in resistance which is observed, when H is added to the alloy in the β phase, is attributed to completion of the d shells of Pd.

A.

537.311.31

7234. On the electrical conductivity of zinc oxide. F. STÖCKMANN. *Z. Phys.*, **127** (No. 5) 563-79 (1950) *In German*.

The electrical conductivity of thin layers of ZnO was measured between 20°C and 80°C . At high and low temperatures its behaviour was found to simulate that of pressed powders. At the higher temperatures the conductivity was found to be a unique function of temperature and O pressure, but independent of the previous history of the sample. At the lower temperatures it was found to depend on the previous

history, but was independent of the O_2 pressure. Irreversible changes of conductivity with time were found in the intermediate temperature range (100°C – 450°C). Observations on the luminescence and photo-conductivity of ZnO had previously suggested that excess Zn can be built into the ZnO lattice in 2 distinct ways. The present measurements, which confirm this result, yield activation energies of 0.8 eV and 1.1 eV for these 2 processes. P. T. LANDSBERG

537.311.31 : 539.23

7235. On the dependence of the electrical resistance of very thin metallic deposits on the applied potential. B. VODAR AND N. MOSTOVETCH. *C.R. Acad. Sci., Paris*, **230**, 2008–10 (June 5, 1950) *In French*.

A theoretical discussion of the experimental results described in Abstr. 6493 (1950). It is concluded that the reduction of potential barriers by the Schottky effect is more important than the tunnel effect or the rise in electronic temperature caused by the field.

R. B. DINGLE

537.311.31 : 621.396.622.6

7236. On certain detector properties shown by thin silver films. A. BLANC-LAPIERRE AND M. PERROT. *C.R. Acad. Sci., Paris*, **230**, 1749–51 (May 15, 1950) *In French*.

The voltage/current relations in thin Ag films, for an applied alternating voltage both with and without a d.c. bias, are described. Very asymmetric curves are obtained; in certain cases important detector effects may be obtained so long as the power dissipated does not exceed $1\ \mu\text{W}$. The results are not explained but it is concluded that Joule heating at least in the film does not account for the effects.

C. A. HOGARTH

537.311.32

7237. The conductivity of cadmium sulphide crystals excited by medium and hard X-rays. I. BROSER, H. OESER AND R. WARMSKY. *Z. Naturforsch.*, **5a**, 214–15 (April, 1950) *In German*.

The conductivity of CdS crystals due to 40–200 kV X-rays was studied in comparison with an ionization chamber. Different wavelength-dependence occurred in each case, the CdS crystal showing a sensitivity max. for 130 kV X-rays.

G. F. J. GARLICK

537.311.32 : 541.133 : 666

7238. Electrolytic conduction in glass. P. L. KIRBY. *Sci. Progr.*, **38**, 257–68 (April, 1950).

A brief non-technical review of silica glass conduction. The phenomenon has been applied recently to effect technological improvements both in the melt and in finishing operations. 20 references given.

R. O. DAVIES

537.311.33

7239. The electrical properties of silicon. B. I. BOLTAKS. *J. Tech. Phys., USSR*, **20**, 3–26 (Jan., 1950) *In Russian*. Review article.

537.311.33

7240. The nature of the electric properties and magnetic permeability of the intermetallic compound Mg_2Sn . B. I. BOLTAKS. *J. Tech. Phys., USSR*, **20**, 180–92 (Feb., 1950) *In Russian*.

The temperature-dependence of the conductivity,

Hall constant, thermo-e.m.f. and magnetic permeability of the compound was investigated, leading to its classification as semi-conductor of the mixed type. From the temperature relation of the magnetic permeability it was concluded that the bond in this compound is of a mixed heteropolar and metallic character. The width of the prohibited zone is 0.2 eV.

B. F. KRAUS

537.311.33 : 621.317.331 : 621.315.592.4

7241. Experimental study of the resistance of some semi-conducting ferrites. C. GUILLAUD AND R. BERTRAND. *J. Rech. Cent. Nat. Rech. Sci.* (No. 11) 73–82 (1950) *In French*.

The resistances of various ferrites were measured over a wide temperature range and for various frequencies, using a Wheatstone network and cathode-ray tube presentation. The specimens were fitted with electrodes in much the same way as thermistors, and in the resistance measurements potential probes were not used.

C. A. HOGARTH

537.311.33

7242. On the electric properties of thin germanium layers. J.-M. DUNOYER. *C.R. Acad. Sci., Paris*, **230**, 1664–5 (May 8, 1950) *In French*.

The layers were evaporated on cold or hot quartz plates. At a temperature of 370°C the resistivity of the layer is small; if below 370°C the resistivity grows quickly, and if it falls below 270°C it is very great indeed. Layers of $1\ \mu$ thickness show a rectifying effect. Amorphous layers have a very high ohmic resistance giving a high rectified voltage in an open circuit and a very small rectified current in a short-circuit. Crystallized layers behave inversely. The two types of layers can be combined to yield relatively high rectified voltages at considerable currents.

W. SUMMER

537.311.33

7243. Electronic processes in zinc fluoride and in the manganese-activated zinc fluoride phosphor. J. H. CRAWFORD, JR. AND F. E. WILLIAMS. *J. Chem. Phys.*, **18**, 775–80 (June, 1950).

Measurements have been made of the temperature-dependence of electrical conductivity and thermal e.m.f. on ZnF_2 and ZnF_2 : Mn, and of the Hall coefficient and rectifying power at 25°C on ZnF_2 . Both ZnF_2 and ZnF_2 : Mn are N-type impurity semi-conductors. The presence of MnF₂ in ZnF_2 decreases the electronic conductivity by a factor of about 10^3 , indicating a decrease in the concentration of electron donors by oxidation. A marked dependence of the temperature variation of conductivity on heat treatment has been observed. Contrary to the simple theory, the absolute values of the thermal e.m.f. increase with temperature. From the Hall coefficient and conductance at 25°C of heat-treated ZnF_2 , a concentration of free electrons of $3 \times 10^{16}\ \text{cm}^{-3}$ and a mean free path of $6.7 \times 10^{-8}\ \text{cm}$ are deduced. ZnF_2 rectifies in the expected direction. A.

537.311.33 : 537.581

7244. On the noise spectra of semi-conductor noise and of flicker effect. A. VAN DER ZIEL. *Physica*, **16**, 359–72 (April, 1950).

It is shown that it is impossible for the noise

intensity to vary inversely proportional to the frequency in the whole interval $0 < f < \infty$, and that a noise intensity which is inversely proportional to the frequency in a wide range can be obtained if a distribution function of correlation times is introduced. The various sources of noise in a semi-conductor are mentioned and it is shown that the "shot effect," discussed by Brillouin, Bernamont and Gisolf is not sufficient to account for all the noise. A few other mechanisms, viz. flicker effect and resistance fluctuations due to the motion of foreign atoms or lattice distortions, are then introduced which give the required distribution of correlation times. Flicker effect is discussed and it is shown that Macfarlane's theory is equivalent to the one discussed here. It is then suggested that flicker effect in oxide-coated cathodes might not primarily be due to the surface of the coating but much more due to what happens inside it. In an appendix it is shown that Bernamont's and Gisolf's treatment of shot noise are equivalent. A.

537.311.33 : 621.314.63

7245. The current-hysteresis of the electrolytic aluminum-oxide rectifier. A. J. DEKKER AND H. M. A. URQUHART. *J. Appl. Phys.*, **21**, 708-13 (July, 1950).

A hysteresis in the rectification of the contact Al/Al_2O_3 /electrolytic solution was found by Dekker and van Geel. In the present paper, measurements of the current-voltage characteristics between 1 and 2 000 c/s are described. A tentative explanation of the hysteresis is given in terms of a pre-breakdown phenomenon. A.

537.311.33 : 621.315.59

7246. Conductivity of liquid selenium—200°–500°C. H. W. HENKELS. *J. Appl. Phys.*, **21**, 725-31 (Aug., 1950).

The resistivity was expressed by $\log_{10} \rho = A + (B/T)$. Average values of A and B were -3.81 and 5.850 . The maximum deviations from the averages were 10 and 3.4% respectively. The resistivity was a function of temperature alone. Various non-metal impurities Cl_2 , I_2 , P lowered the resistivities and produced different values of B in different temperature ranges. Hg addition caused no change in either A or B although that metal greatly influences the resistance of solid hexagonal Se. Melts doped with Cl_2 or Br_2 , along with Hg, exhibited behaviours different from those with single additions. It was concluded that Se is an ideal semiconductor in the range of measurement. A.

537.312.5

7247. Some optical properties of antimony-caesium photocathodes. N. YA. KARKHANINA AND N. D. MORGULIS. *J. Tech. Phys., USSR*, **20**, 345-52 (March, 1950) In Russian.

The authors used a method previously developed by them, viz. that of a Sb-Cs wedge. The programme of the investigations was the determination of the coefficients of refraction and absorption; the direct and inverse photo-effect along the wedge on glass and Pt-supports for various wavelengths. It was shown that the distribution of the effect along the wedge is determined by the energy distribution of the

optical wave at a depth $0 < d < 15 m\mu$ below the surface; the orders of magnitude of the paths of the photo-electrons within the cathode, their energy losses, etc., were also determined. The possible influence of inhomogeneities of the structure on the oscillations of the direct photo-current along the wedge, which had been established, was investigated by taking spectral curves of the direct effect at different points of the wedge. B. F. KRAUHL

537.312.5

7248. Sensitization of composite surfaces in a photoelectric multiplier by oxygen. S. M. FAINSHTEIN. *J. Tech. Phys., USSR*, **20**, 363-7 (March, 1950) In Russian.

The sensitization of the Sb-Cs cathode of a photoelectric multiplier with O subsequent to the activation of these layers with Cs was found to result in an increase of the photosensitivity of the cathode and the total sensitivity of the multiplier. It has no adverse effect on the secondary electron emission of a Cu-S-Cs emitter which it even stimulates in some cases. The O-sensitization of the Sb-Cs cathode does not always increase the sensitivity in the red part of the spectrum however. The dark current of O-sensitized photoelectric multipliers remains within the same limits as that of non-sensitized multipliers. B. F. KRAUHL

537.312.5

7249. On the photoconductance of solid anthracene. A. T. VARTANYAN. *Dokl. Akad. Nauk, SSSR*, **71** (No. 4) 641-2 (1950) In Russian.

The results obtained by Bayliss and Riviere [Abstr. 7020 (1949)] have not been confirmed. It is suggested that these authors did not exclude the external photoeffect. F. LACHMANN

537.312.5 : 535.215.44

7250. On some properties of complex photoelectric layers. A. LALLEMAND AND M. DUCHESNE. *Z. angew. Math. Phys.*, **1**, 195-201 (May 15, 1950) In French.

The electronic image of a photocathode was observed on a fluorescent screen by means of an image converter; the brilliance of this screen was taken as a measure of the electron current striking it (10^{-15} A). Ag-Cs₂O-Cs layers were shown to be sensitive up to 15 000 Å and the photoelectric emission conformed closely to Fowler's theory. Discrepancies are explained by assuming that certain centres have a work function much smaller than that according to the theory. If a sufficiently large number of such centres are attained in the Ag-Cs₂O-Cs layer the long wave threshold of sensitivity will move further into the infra-red. W. SUMMER

537.312.6 : 536.48

7251. Resistivity of pure metals at low temperatures. II. The alkaline earth metals. D. K. C. MACDONALD AND K. MENDELSSOHN. *Proc. Roy. Soc. A*, **202**, 523-33 (Aug. 22, 1950).

In continuation of the work reported in the first paper of this series [Abstr. 6492 (1950)] the electrical resistivity of Be, Mg, Ca, Sr and Ba has been investigated in detail in the temperature region below 20°K. In most cases the resistance was also determined in the range up to liquid-air temperatures in order to

obtain estimates of the Debye characteristic temperatures, which are compared with data obtained by other methods. A striking feature is the occurrence of a pronounced minimum in the resistance of Mg below 10°K which was exhibited by all 4 specimens investigated.

A.

537.312.62

7252. On Heisenberg's theory of superconductivity. KUN HUANG. *Nat. Peking Univ. Semi-Cent. Vol., Math. Phys. Biol. Ser.*, 89-101 (1948).

It is pointed out that the wave packets used by W. Heisenberg to form the correlation lattice in his recent theory of superconductivity [Abstr. 3203 (1947)] are not mutually orthogonal; the method used for obtaining their density is therefore accordingly arbitrary. This, in particular, invalidates the result that the total energy of the system can always be reduced by the formation of the correlation lattice. This result is again proved in this note by following essentially the method used by Heisenberg, but using a lattice of orthogonal wave packets. The crude estimate of the transition temperature that follows from the treatment agrees in order of magnitude with that of the usual superconductor better than that given in Heisenberg's original work. The note is concluded with a brief discussion of the exchange correlation energy which shows that conclusions reached without taking account of this effect more properly are necessarily somewhat uncertain.

A.

537.312.62

7253. Superconductivity of lead. H. A. BOORSE, D. B. COOK AND M. W. ZEMANSKY. Letter in *Phys. Rev.*, 78, 635-6 (June 1, 1950).

Determination of the transition temperature of a cylindrical Pb specimen of high purity which formed the core of a mutual inductance. The primary was actuated by 1 000 c/s a.c. producing a maximum field of 1.5 oersteds. The value found ($7.22^{\circ}\text{K} \pm 0.02^{\circ}$) agrees well with the results previously obtained by other methods.

H. LONDON

537.312.62

7254. Magnetic field penetration in superconducting lead. M. C. STEELE. *Phys. Rev.*, 78, 791-3 (June 15, 1950).

The magnetic susceptibility of small superconducting Pb spheres (radius $\sim 10^{-3}$ cm) has been determined by a self-inductance method. On the basis of relations derived from the London theory for reducing the data, the penetration depth, λ , is calculated for 3 different Pb samples at 4.22°K . Results indicate that λ is $1.3 \pm 0.3 \times 10^{-5}$ cm at this temperature. In addition, it is found that, within experimental error, λ is not a function of the size of the sphere. It is noted that there is need for using smaller sized particles and accounting for the interaction effects if future colloid investigations designed to test the London theory are to be successful.

A.

537.312.62 : 539.374

7255. Influence of plastic deformation on the superconductivity of metals. V. I. KHOTKEVITCH AND V. R. GOLIK. *J. Exp. Theor. Phys., USSR*, 20, 427-37 (May, 1950) *In Russian*.

The plastic deformation of Sn, In and Tl at low

temperatures leads to the formation of a metastable condition, characterized by an increased value of the critical temperature. The existence of a maximum on the curves of critical temperature v. degree of plastic deformation is due to the superposition on this effect of the result of volume compression, reducing T_{cr} . The results lead to the conclusion that possibly the phase transformation $\text{Ti}\alpha\text{-Ti}\beta$ observed by Bridgman takes place. The effects observed are conditional upon low temperatures and do not occur under deformations at higher temperatures, even though they still might be below recrystallization temperature. The plastic deformation of Hg does not give rise to similar effects. The observed lowering of T_{cr} is due to the volume compression.

B. F. KRAUS

537.312.8

7256. The conductivity of thin wires in a magnetic field. R. G. CHAMBERS. *Proc. Roy. Soc. A*, 202, 378-93 (Aug. 7, 1950).

A thin film or wire of metal has a lower electrical conductivity than the bulk material if the thickness is comparable with or smaller than the electronic mean free path. Previous workers have obtained expressions for the magnitude of the effect by integrating the Boltzmann equation and imposing the appropriate boundary conditions. The problem is re-examined from a kinetic theory standpoint, and it is shown that the same expressions are obtained by this method, usually rather more simply, while the physical picture is considerably clarified. The method is applied to an evaluation of the conductivity of a thin wire with a magnetic field along the axis, and it is found that the resistivity should decrease as the magnetic field is increased; it should be possible to derive the mean free path and velocity of the conduction electrons by comparison of theory and experiment. The theory has been confirmed by experimental measurements on Na; estimates of electronic velocity and mean free path are obtained which are in fair agreement with the values given by the free-electron theory.

A.

537.32 : 536.7

7257. The thermodynamics of thermoelectricity. II. J. E. VERSCHAFFELT. *Bull. Acad. Roy. Belge, Cl. Sci.*, 35 (No. 3) 193-206 (1950) *In French*.

The ideas of the author's first paper [Abstr. 5850 (1950)] are further developed. The fundamental equations for a crystal with both translational and rotational anisotropy are established, and the Bridgman effect is explained in terms of the tensor character of the entropy. It is considered that the tensor is symmetrical and in the case of simple rotational anisotropy it becomes a scalar.

C. A. HOGARTH

537.36

7258. The electrokinetic behaviour of Iceland spar against aqueous electrolyte solutions. H. W. DOUGLAS AND R. A. WALKER. *Trans. Faraday Soc.*, 46, 559-60 (July, 1950).

An electro-osmotic method has been used to determine the zeta potential of pure Iceland spar against CO_2 -free water, its own saturated solution, and the effect of increasing concentration of dissolved electro-

lytes, CaCl_2 , BaCl_2 , $\text{Pb}(\text{NO}_3)_2$, MgCl_2 , NaCl , Na_2CO_3 , $(\text{NaPO}_3)_6$ and others. The initial negative zeta potential of the calcspar, and its variation with dissolved electrolytes, was found to depend on its pre-treatment. In particular, etching with very dilute mineral acid caused the potential to shift irreversibly to more negative values, an effect consistent with irregular pitting of the surface as shown by the electron microscope. The results have been considered in terms of an electrical double layer of the Stern type, of the crystal surface and hydration forces acting on the various ions, Ca^{++} and CO_3^{--} in particular, and of the Paneth-Fajans rules for adsorption on to ionic lattices. The results indicate strong adsorption of positive ions to form a series $\text{Ca}^{++} > \text{Ba}^{++} > \text{Pb}^{++} > \text{Mg}^{++} > (\text{Na}^+ \text{ as reference})$, and of negative ions to form a series, Cl^- (as reference) $< \text{OH}^- < \text{HCO}_3^-$ or $\text{CO}_3^{--} < (\text{PO}_3^-)_6$. A.

ELECTRIC DISCHARGES 537.52

537.521

7259. The space periodicity of the gas discharge. A. A. LOGUNOV. *J. Exp. Theor. Phys., USSR*, 20, 458-64 (May, 1950) In Russian.

The equation for the distribution function of the electrons in the plasma is derived, considering recombination of the electrons, ionization and excitation of the molecules and atoms of the gas, and also the collisions of the electrons with the atoms and molecules leading to scattering of the electrons. A special case is also investigated, where only diffusion is considered, and this is applied to a demonstration of the space periodicity of the gas discharge. In a linear approximation periodic solutions are obtained for the electron density. The existence of such periodic solutions proves the exceptional importance of processes of interaction from a distance and the setting-up of periodic processes in the plasma, confirming Vlasov's idea of their fundamental importance for gas discharge processes. Yet the derivation of the dispersion equation from Vlasov's equation is not unambiguous, because Vlasov's equations do not determine a unique steady distribution, independent of the co-ordinates of space. Also, the Vlasov equations do not permit ionization, excitation and recombination to be considered in the more detailed stratified investigation, where the author's method is more successful and less artificial. B. F. KRAUS

537.521.6 : 538.12

7260. On the theory of the electric discharge potential in a transverse magnetic field. G. VALLE. *Nuovo Cim.*, 7, 174-89 (May, 1950) In Italian.

A theory is developed that permits of exactly predicting the variations of the Paschen diagram with increasing intensity of the magnetic field. The limits are calculated between which the discharge is initiated by the magnetic field. The 3 characteristic cases are fully elucidated, namely: that of a discharge in a vacuum; that of a discharge in a gas at low pressure or between electrodes of bigger geometrical distances;

and, finally, that of transition where the discharge potential first falls with an increasing magnetic field and, after passing through a minimum, begins to rise slowly. W. SUMMER

537.523.4 : 517.6

7261. A short method for evaluation of the Townsend integral for electron avalanche formation. E. E. DODD. Letter in *Phys. Rev.*, 78, 620 (June 1, 1950).

537.523.5

7262. The retrograde motion of the arc cathode spot. C. J. GALLAGHER. *J. Appl. Phys.*, 21, 768-71 (Aug., 1950).

The motion of the cathode spot in a direction opposite to that predicted by Ampere's law depends on the arc current, gas pressure, kind of gas, and magnetic field strength. Studies of the effects of these variables have been made, including measurements of velocity and the critical pressure at which reversal of motion occurs. The phenomena observed have not been clearly explained by any of the pictures presented to date. The existence of the retrograde motion indicates very strongly that the positive-ion space charge outside the cathode is all-important in determining the mechanism of current transfer. A.

537.525 : 621.327.43

7263. Spiraling in fluorescent lamps. R. VAN MALE DE GHORAIN AND A. LUYCKX. *J. Electrochem. Soc.*, 97, 159-65 (May, 1950).

Factors which produce or affect spiraling in low pressure discharges are discussed and studied in tubes of normal fluorescent lamps and of special design. The order of magnitude of the forces in a discharge is calculated from magnetic deflection measurements. Tension forces in one constricted but not spiraling type of discharge were found to be 10-30 dynes. Spectroscopic study of the constricted and magnetically distorted plasma revealed the presence of barium, Sr, and probably Ca. The theory of Langmuir, *et al* of the constricting sheath has been applied with the modification that in fluorescent lamps the sheath is believed to be caused by sputtered alkaline earth vapours or aggregates instead of tungsten vapours or aggregates, while the role of carbon aggregates is still uncertain. A.

537.525.5

7264. On the controlled low pressure mercury arc and its voltage/current characteristic. H. FETZ AND A. HAUG. *Z. angew. Phys.*, 2 (No. 4) 150-2 (1950) In German.

Gives a brief descriptive account of problems relating to controlled arcs (such as that in a grid controlled rectifier) and deals especially with the effect of plasma formation (at a grid) on control. J. D. CRAGGS

537.525.5

7265. X-ray determination of Hg arc temperature. C. KENTY AND W. J. KARASH. Letter in *Phys. Rev.*, 78, 625 (June 1, 1950).

537.525.5

7266. The temperature of the mercury arc. C. KENTY. Letter in *Phys. Rev.*, 78, 626-7 (June 1, 1950).

537.525.5 : 536.221 : 621.3.064.2

7267. A study of cathode phenomena in the mercury arc. A. LUTZ. *Rev. Gén. Elect.*, 59, 153-69 (April, 1950) *In French*.

This comprehensive investigation covers: (i) a study of the temperature of the cathode region of the Hg surface from measurements of its infrared emission; (ii) the dependence of the temperature ($\approx 100^\circ\text{C}$) of the cathode hot-spot on its area, and measurements of the flux of heat dissipated by conduction in the Hg (these thermal measurements are made by methods analogous to those of the electrolytic bath); (iii) a theoretical study of the energy balance of the cathode current; and (iv) some experimental data on the flow of neutral Hg vapour in the arc.

F. LLEWELLYN JONES

537.525.8

7268. A study of irregular electron oscillations in an electrodeless high-frequency discharge under the influence of a constant magnetic field. B. KOCH AND H. NEUBERT. *Ann. Phys., Lpz.*, 7 (No. 1-2) 97-102 (1950) *In German*.

Describes the generation and detection of electron oscillations for $p \sim 10^{-3}$ mm, as a function of the magnetic field and of the electrical parameters of the discharges. Frequencies studied were ~ 20 Mc/s. A brief discussion of the relation between these oscillations and plasma oscillations produced in the absence of magnetic fields is given.

J. D. CRAGGS

537.525.8

7269. On the variation of current with distance between the electrodes of a glow discharge in gases at low pressure. M. K. HUSAIN. *Indian J. Phys.*, 24, 73-9 (Feb., 1950).

Measurement of current strength with variation of distance between the electrodes of a glow discharge reveals that with the anode in the negative glow the current shows a maximum before falling to zero when the anode reaches the boundary of the cathode dark space. In the present paper it is suggested that when the anode is in the negative glow a stream of positive ions flows from the negative glow to the cathode dark space, which is not inconsistent with the assumptions of J. J. Thomson.

A.

537.525.8

7270. The role of cathode temperature in the glow discharge. H. JACOBS AND J. MARTIN. *J. Appl. Phys.*, 21, 681-5 (July, 1950).

Experiments were conducted to study the role of the temperature of oxide-coated cathodes in the glow discharge of A, Ne and mixtures of Ne and A, and Hg vapour and A. It was found that for tubes without Hg present, in the region of cathode temperature between 300°K and 750°K : (1) The sparking potential falls with increasing cathode temperature. (2) The regulation voltage rises with increasing cathode temperature. For A and Hg vapour the regulation voltage falls with increasing cathode temperature. The action here is attributed to metastable states of inert gas. (3) The current density in the glow discharge decreases with increasing cathode temperature. This, too, is attributed to the action of metastable states. (4) The minimum sus-

taining current in a glow discharge is found to decrease with increasing cathode temperature and rise with increasing pressure. (5) The current density in the glow discharge varies roughly linearly with pressure, or at a slightly higher rate, in contrast with the space-charge derivations which claim a variation with (pressure)². (6) The regulation voltage tends to rise very slightly at lower pressures.

A.

537.525.8 : 536.521

7271. The problem of the temperature of the torch discharge. K. N. MOCHALOV, A. YA. NIKIFOROV AND A. S. BOGONOSTSEV. *J. Exp. Theor. Phys. USSR*, 20, 474-7 (May, 1950) *In Russian*.

The authors measured the temperature of the external zone of the discharge at 50 Mc/s by the method of producing the spectral lines of Li, Na and Ti. On the outer boundary of this zone the temperature is 2200°K and gradually increases towards the axis of the discharge. In the internal zone there is apparently a deviation from the thermal character of the excitation of the spectrum. On the electrode spot the excitation is, without doubt, of non-thermal character.

B. F. KRAUS

537.525.83

7272. Glow discharge in mercury vapours. N. L. MINDLIN. *J. Tech. Phys., USSR*, 20, 175-9 (Feb., 1950) *In Russian*.

The normal cathode drop of the glow discharge, measured in Hg vapour on graphite, Fe and Hg cathodes, was found to depend little on the cathode material, and was approximately equal to 250 V. This value is by more than $100\text{ V} <$ that found by Köppen [*Z. Phys.*, 75, 654 (1932)], though foreign gases and electrode evaporation might have had some effect. The measured current densities of the glow discharge were lower than Köppen's values by factors of 10 or more. The comparison of the author's values with the back current densities in Hg rectifiers showed that the fraction of back current corresponding to the glow discharge represents only a negligible percentage of the total back current.

B. F. KRAUS

537.527

7273. Influence of its magnetic field and of diffusion on the resistance-stabilized low-current arc. W. WEIZEL AND G. ECKER. *Z. Phys.*, 127 (No. 5) 495-512 (1950) *In German*.

Energy balance and transport equations for the arc are set up, and the effects of bi-polar diffusion, thermal diffusion, and of the magnetic field of the arc current are considered. The effects of excited atoms are found to be negligible: the influence of its own magnetic field could be ignored in the ordinary Hg and noble gas arcs but not in the high-current C arc; thermal diffusion only introduces a correction term to the bi-polar diffusion. All these effects modify the Elenbaas-Heller equation, but it is shown that the new form can still be integrated mechanically.

F. LLEWELLYN JONES

537.527.3

7274. Negative wire corona at high temperature and pressure. L. R. KOLLER AND H. A. FREMONT. *J. Appl. Phys.*, 21, 741-4 (Aug., 1950).

The corona characteristics of air and methyl chloride

were studied in a modified type of Cottrell precipitator at temperatures from room temperature to 500°C and pressures from 1 to 5 atmospheres. Within this range the corona current is a power function of voltage, with gas density as a parameter. This power is independent of density. Values are given for air and methyl chloride.

A.

537.529 : 621.3.015.5 : 621.315.61

7275. Intrinsic dielectric breakdown in solids. H. FRÖHLICH AND J. H. SIMPSON. *Adv. Electronics*, **2**, 185-217 (1950).

In this review of recent developments, the authors first outline the properties of electrons in insulating materials, then proceed to an account of the theory of electric breakdown. The results of the theory, both for the high- and the low-temperature region, are outlined, and a comparison made with experimental observations. 24 refs.

X-RAYS 537.531

537.531

7276. Determination of the quality of X-rays. S. M. ALY. *Proc. Math. Phys. Soc. Egypt*, **4**, 41-51 (May, 1949).

Two air-wall ionization chambers were used for the direct measurement of I_x/I_0 for a set of beams of X-rays of different quality. Absorption curves were constructed and the half-value layers of the beams were determined. The energy distribution curves were calculated from the Silberstein-Jones formula for beams where the formula fits the absorption data obtained. A comparison was made between the results obtained from the measurement by a Siemen's ionization chamber and dosimeter, and those obtained from the above method.

A.

537.531

7277. The resolving power of an X-ray microscope. E. PRINCE. *J. Appl. Phys.*, **21**, 698 (July, 1950).

A formula for determining the resolving power of an X-ray microscope built according to the design suggested by Kirkpatrick and Baez is derived, and an estimate given. The optimum resolving power is such as to resolve points separated by a distance of the order of 2 000 Å.

A.

537.531 : 535.33

7278. The satellites of the X-ray line $M\beta$. F. R. HIRSH, JR. Letter in *Physica*, **16**, 377-8 (April, 1950).

537.531 : 535.33

7279. On the form of the $K\alpha_{1,2}$ lines of the X-ray spectra of the atoms of nickel in simplest chemical compounds. III. E. E. VAÏNSHTEÏN. *J. Exp. Theor. Phys. USSR*, **20**, 442-5 (May, 1950) In Russian.

An experimental investigation of the form and width of the lines in oxides and sulphides. The index of asymmetry of the lines was found to depend on the method of preparation of the oxides. A new interpretation of the asymmetry of the $K\alpha_{1,2}$ lines is suggested.

B. F. KRAUS

537.531 : 535.33

7280. Form of the $K\alpha_{1,2}$ x-ray lines of the atoms of copper and nickel in alloys of the Ni-Cu system. IV. E. E. VAÏNSHTEÏN. *J. exp. theor. Phys.*, **20**, USSR 446-50 (May, 1950) In Russian.

The experimental investigation led to the following conclusions: The indices of asymmetry of the lines in an alloy in the paramagnetic and ferromagnetic states are substantially different. If in the paramagnetic state of the alloy the Ni lines are more asymmetrical, the inverse relation holds in the ferromagnetic state. This is particularly marked for the $K\alpha_1$ lines. The $K\alpha_{1,2}$ lines of the atoms of Ni are more symmetrical in the ferromagnetic state of the alloy. As regards the $K\alpha_{1,2}$ lines of Cu, the ferromagnetic-paramagnetic transition of the alloy leads to a change in the direction of the asymmetry of these lines. In the change of the magnetic state of the alloy the width of the $K\alpha_{1,2}$ lines of both components remains practically unaffected.

B. F. KRAUS

537.531 : 535.44

7281. Some formulas for the X-ray scattering from atoms in various spatial probability distributions. M. V. KING AND W. N. LIPSCOMB. Note in *Acta Cryst.*, **3**, 318-19 (July, 1950).

537.531 : 535.43 : 539.215.1

7282. Average electron density measurements by low angle X-ray scattering. H. M. BARTON, JR. AND R. BRILL. *J. Appl. Phys.*, **21**, 783-5 (Aug., 1950).

According to Guinier the low-angle X-ray scattering of particles should disappear when they are immersed in a fluid of equal electron density. This furnishes a way of measuring the electron density of powders providing a suitable impregnating fluid can be found. Experiments of this type have been carried out with carbon black. A method of calculating the low-angle scattering coefficient defined by Warren is given for impregnated samples. Measurements of the total low-angle scattering intensity were made using a double-crystal spectrometer and Geiger counter. No liquid was found that would give complete matching but approximate matching was obtained with phosphoric acid solution. The data extrapolate to show an electron density of $(1.1 \pm 0.1)N$ where N = Avogadro's number. This compares with a value of $0.99N$ as calculated from the He immersion mass density measurement on the same sample.

A.

537.531 : 621.386.1

7283. X-ray tube producing a beam of X-rays convergent to a point. C. H. BACHMAN AND S. J. SILVERMAN. Letter in *J. Appl. Phys.*, **21**, 615 (June, 1950).

537.531.08 : 615.849 : 621.386.83

7284. Marconi-Farmer X-ray dosimeter. R. J. YATES. *Marconi Instrum.*, **2**, 75-8 (Feb.-March, 1950).

A small ionization chamber placed in the X-ray beam is connected across a charged capacitor so as to discharge when ionization occurs. The rate of discharge is dependent on the radiation intensity, which can be measured by the rate at which the capacitor is re-charged by a blocking oscillator switching system.

triggered by an electrometer valve. The indicator unit includes a dosage dial integrating the total dose given over a period, and a chamber discharge meter for general checking. The apparatus will switch off X-ray equipment when a pre-determined dose has been administered, and operate an alarm buzzer.

E. D. HART (R)

CATHODE RAYS . POSITIVE RAYS 537.533/534

537.533 : 519.2

On the stochastic theory of continuous parametric systems and its application to electron cascades. See Abstr. 6945

537.533 : 621.384.6

7285. On the theory of the radial oscillations of the electrons in an electron accelerator. H. JAHN AND I. KOPFERMANN. *Ann. Phys., Lpz.*, **6**, 305–20 (1949) in German.

Approximate formulae are given for the oscillations of finite amplitude of an electron about its orbit in the electromagnetic field of an electron accelerator. A family of curves is drawn of the angular momentum against radius. These curves indicate the stability of the orbit. This family of curves changes slowly during the acceleration. In particular the damping of the finite oscillations is considered and applied for the field of the 6 MeV betatron of the Siemens-Reiniger-Werke.

W. I. B. SMITH

537.533 : 621.384.6

7286. Theory of the capture process in a betatron-injected synchrotron. D. C. DE PACKH AND M. BIRNBAUM. *Rev. Sci. Instrum.*, **21**, 451–6 (May, 1950).

The investigation of electrons of all possible initial phases and phase velocities at transition between betatron and synchrotron phases of an electron-synchrotron has been undertaken to determine the effect of different ways of applying the r.f. It has been found that for an average accelerator there is an advantage in a moderately slow increase of the voltage from zero to its final value, while for the extreme case where particles enter the transition region with large phase velocity, an asymptotic final radial oscillation amplitude is reached which is independent of the manner in which the voltage is applied, provided only that it is applied adiabatically.

A.

537.533 : 621.384.6

7287. An 80-Mev model of a 300-Mev betatron. D. W. KERST, G. D. ADAMS, H. W. KOCH AND C. S. ROBINSON. *Rev. Sci. Instrum.*, **21**, 462–80 (May, 1950).

The construction and operation of a flux-biased 80 MeV betatron is described. This betatron was built as a model to test design features later to be incorporated in a 300 MeV betatron. Particular attention is paid to factors influencing design and to magnetic problems common to betatrons and synchrotrons such as the construction of field magnets which are uniform, the testing of fields at injection time, the mechanism of electron capture, and the

influence of field inhomogeneities. The dimensions and operating characteristics are included together with many comparisons with the 300 MeV betatron.

A.

537.533.7

7288. Theory of the Cherenkov effect. M. L. LEVIN. *J. Exp. Theor. Phys., USSR*, **20**, 381–3 (April, 1950) in Russian.

The classical theory of the Cherenkov effect, i.e. the field of an electron moving along the z-axis at speed v , representing a "linear current," is found by a Fourier expansion and vector potential representation leading to Hankel functions [see Tamm and Frank, *Dokl. Akad. Nauk, SSSR*, **14**, 109 (1937); Tamm, *J. Phys., USSR*, **1**, 439 (1939)]. However, the divergence of the Hankel functions prevents the determination of the field near the electron, which is of particular interest because on principle the Cherenkov effect may be used for the production of ultra-short radio-waves. The author shows that a representation by retarded potential, using the well-known Sommerfeld expansion involving the zero-order Bessel function, enables the Fourier-component of the interaction force between two electrons moving in parallel directions to be determined. At close distances this is a strong braking effect which, however, quickly decays with increasing distance, owing to the oscillations of the Bessel function. In a special case, Tamm and Frank's formula for the reaction force of the radiation of the Cherenkov electron is obtained.

B. F. KRAUS

537.533.72

7289. The use of secondary electrostatic focusing in a magnetic beta-ray spectrograph. R. D. HILL, J. W. MIHELICH AND M. T. PIGOTT. Note in *Rev. Sci. Instrum.*, **21**, 498–9 (May, 1950).

537.533.72

7290. Magnetic spectrometer of large solid angle. E. R. RAE. *Phil. Mag.*, **41**, 525–33 (June, 1950).

An account is given of a magnetic spectrometer of large solid angle and good resolution which should find applications in the study of complex beta-ray spectra by the method of beta-gamma coincidences. The original apparatus, consisting of a segmented annular G.M. counter set round a radioactive source in a magnetic field is described, the method of use being to select from the output of the counter, large pulses which correspond to the simultaneous triggering of several sections by the passage of an electron tangentially to the annular counter. The performance of the instrument is discussed and modifications are described which rectify the defects in the earlier design and give a solid angle of 2.5% of 4π with a resolution of 5% . The geometry of this type of spectrometer is considered and the performance which might be obtained with good design is discussed. It is concluded that collecting angles up to the order of 50% of 4π are possible with good resolution.

A.

537.533.72 : 539.165

7291. An electron pair spectrometer of lens type for hard gamma-radiation. K. SIEGBAHN AND S. JOHANSSON. *Rev. Sci. Instrum.*, **21**, 442–5 (May, 1950).

The rotation of the image in a short magnetic lens

is used to separate negatrons and positrons by putting the pair converter a little aside from the optical axis of the lens. It is then possible to obtain coincidence "lines." The apparatus has been tried on the 2.62-MeV γ -ray of ThC" and the 2.76-MeV γ -ray of Na²⁴. A.

537.533.72 : 621.385.832

7292. Note on the image formation in cathode-ray tubes. R. DORRESTEIN. *Philips Res. Rep.*, 5, 128-30 (April, 1950).

The theory of Gaussian beams is applied to the electron beam in a c.r.t. with a conventional type of gun. It appears that in principle neither the paraxial cross-over, nor the cathode image, but rather some intermediate point is to be imaged on the screen in order to yield the smallest possible spot. However, in practical cases this intermediate point nearly coincides with the cross-over, which agrees with the generally accepted concept of image formation in c.r.ts. A.

537.533.72 : 621.385.833

7293. Electron lenses. P. GRIVET. *Adv. Electronics*, 2, 47-100 (1950).

A review of the development of electron lens theory over the last ten years. Section headings: Image formation in a thin lens. Magnetic lenses. Relativistic lenses. Image defects. Third-order aberrations. Mechanical defects. Some typical lenses. 100 refs.

537.533.72 : 621.385.833

7294. Field plotting and ray tracing in electron optics. A review of numerical methods. G. LIEBMANN. *Adv. Electronics*, 2, 101-49 (1950).

A comprehensive resume of analytical, numerical, graphical and experimental methods, including also automatic ray tracing methods (rubber membrane, etc.). 129 refs.

537.533.72 : 621.385.833

7295. Limitation of the resolving power of the electron microscope due to changes in the object. H. BOERSCH. *Z. Phys.*, 127 (No. 4), 391-9 (1950) In German.

Considers effects, such as transformation of nitrocellulose into C, which depend on the total electron dosage. A calculation of the dosage required to produce a visible picture is made on the basis of a consideration of the number of electrons which must pass through the circle of confusion in order to obtain a deviation greater than the purely statistical deviation from the mean current. The effect on resolving power follows from the fact that the greater the number of electrons required to obtain a picture the less probable is it that the object structure will remain unaltered. An explanation of the increased difficulty in obtaining resolving powers better than 20 Å is given.

A. H. W. BECK

537.533.72 : 621.385.833

7296. Simple expressions for the focal distance and chromatic aberration for an extended family of electrostatic lenses. E. REGENSTREIF. *C.R. Acad. Sci., Paris*, 230, 630-2 (Feb. 13, 1950) In French.

See Abstr. 3182 (1950). The expressions derived for the axial potential distribution in the "einzellinse"

are used to calculate the focal distance and chromatic aberration for medium and small focal powers. The agreement between the calculated values and those deduced from trough plots is good for the focal distance but only fair (error about 15%) for the aberration constant.

A. H. W. BECK

537.533.72 : 621.385.833

7297. Principal rays for a family of electron lenses and mirrors. E. REGENSTREIF. *C.R. Acad. Sci., Paris*, 230, 1262-4 (March 27, 1950) In French.

See Abstr. 5040 (1950), recent papers on same subject. Gives the explicit expressions for the Gaussian trajectories in the family of "einzellinsen" previously studied. The coefficients depend directly on the dimensions and voltages.

A. H. W. BECK

537.533.72 : 621.385.833

7298. The independent electrostatic lens for nonparaxial rays [régime transgaussien]. E. REGENSTREIF. *C.R. Acad. Sci., Paris*, 230, 1650-2 (May 8, 1950) In French.

The properties of the "einzellinse" are calculated, retaining terms in ξ^3 . Relations giving the principal surfaces, caustic surfaces, etc., are derived in terms of the fundamental parameter $x = \phi(0)/\phi(z_0)$ and the parameter giving the incidence ξ_0/z_0 . The limiting value of ξ_0/z_0 beyond which the lens acts as a mirror is also determined.

A. H. W. BECK

537.533.72 : 621.385.833

7299. The determination of electron microscope magnification. R. S. PEASE. *J. Sci. Instrum.*, 27, 182-6 (July, 1950).

Electron microscope magnifications are usually measured by using standard objects, and calibrated in terms of lens currents. Accuracy and convenience of this method are limited by the reproducibility of microscope conditions, and by image distortion. A method in which movements of the object and image are measured and compared has been developed, which has none of these limitations. Movements of the specimen stage were investigated directly with a variable-gap Fabry-Pérot interferometer mounted inside the microscope. After introducing refinements to the stage mechanism, specimen movements of the order of 5 μ were controlled and measured with the interferometer to within 1%. Mechanical measurement of specimen movements using a calibrated fine control, which is much more convenient for everyday use, is capable of the same order of accuracy.

A.

537.533.72 : 621.385.833

7300. Electron optical properties of space-charge clouds. L. MARTON AND D. L. REVERDIN. Letter in *J. Appl. Phys.*, 21, 842 (Aug., 1950).

537.533.74

7301. On the scattering of fast electrons. S. S. GUPTA AND P. P. CHATTARJI. Letter in *Curr. Sci.*, 19, 146-7 (May, 1950).

537.533.74 : 539.165

7302. Nuclear scattering of fast β -particles in the cloud-chamber: projected form of Mott's and other scattering formulae with tables. C. O'CEALLAIGH. *Proc. Roy. Irish Acad.*, 53 A, 133-44 (March, 1950).

The form taken by scattering formulae when

projected on a photographic plane is developed for the particular conditions of cloud chamber experiments, viz. a minimum length of trajectory required both before and after collision for curvature measurements and the whole to fall within the defined volume set by the chamber illumination. J. G. WILSON

537.533.74 : 539.165.08

Back-scattering of electrons into Geiger-Müller counters. See Abstr. 7470

537.533.75

7303. The maximum range of high energy electrons in aluminum and copper. F. L. HEREFORD AND C. P. SWANN. *Phys. Rev.*, **78**, 727-31 (June 15, 1950).

This has been measured in the region of energy from 3 to 12 MeV. The magnetically analysed beta-ray spectrum of B^{12} was employed, range values being determined from absorption curves obtained with a triple coincidence counter train. The values so obtained fall below a semi-empirically computed curve normalized with experimental data in the region of electron energy below 3 MeV. It is shown that the discrepancy can be explained if the influence of multiple scattering effects in the absorber is considered. On this basis the data indicate that the difference between the "absolute maximum range" and the "practical maximum range" increases with electron energy. A.

537.533.75 : 615.849

7304. Physical action and biological effects on objects irradiated with fast electrons. W. PAUL AND G. SCHUBERT. *Naturwissenschaften*, **37**, 156-63 (April, 1950) In German.

The range and intensity distribution of the electron beam from a 6 MeV betatron was investigated by the coloration of KCl crystals. Photometry of crystals gives distribution of ion density. The dose rate at 30 cm was $\sim 1\,000$ r/min. Radiobiological experiments on barley seedlings and drosophilla indicates the relative biological efficiency of fast electrons is ~ 0.55 compared with 200 kV X-rays. Since the range of the 6 MeV electrons in tissue is 2-3 cm their possible application to superficial radiotherapy is discussed. T. A. CHALMERS

537.533.9

7305. The Cherenkov effect. S. ROBIN. *J. Phys. Radium*, **11**, 17D-22D (May, 1950) In French.

This review paper gives, with 25 references, a comprehensive account of the theory of, and expts. with, Cherenkov radiation. An account of the theory is followed by sections on physical effects producing the radiation, on experimental investigations, on interference and spectral energy distribution and finally on possible uses of the radiation. J. D. CRAGGS

537.533.9 : 778.3

7306. Particle identification in photographic emulsions by the delta-ray method. L. VOJVODIC. *Canad. J. Res.*, **A**, **28**, 315-23 (May, 1950).

A comparison is made in this study between the δ -ray densities expected theoretically and those observed experimentally on charged particle tracks in Ilford G5 emulsions. The energies of δ -rays are determined here by means of grain-counting measure-

ments and energy-loss considerations. Using this method of energy determination and the theoretical formula for δ -ray density, good agreement has been found with the experimental distributions on proton, μ -meson, deuteron and α -particle tracks. The agreement is satisfactory both in absolute value and in the shape of the δ -ray density distribution. These results are considered to show that the δ -ray technique is suitable as an absolute method of charged particle identification in photographic emulsions. A.

537.534 : 621.384.6

7307. Phase-focusing in linear accelerators and in spiral-accelerators. W. DÄLLENBACH. *Ann. Phys., Lpz. (Folge 6)* **3**, 89-100 (1948) In German.

Two systems of linear difference equations (energy and kinematic) are given for recursive calculation of the phase and energy after a number of accelerations for arbitrary initial conditions. The phase stability diagrams are given for a particle in an arbitrary phase as a function of the stable phase for the linear accelerator [R. Wideröe, *Arch. Elektrotech.*, **21**, 387 (1928)] and for the spiral accelerator [W. Dällenbach, *Helv. Phys. Acta*, **21**, 21 (1948)]. W. I. B. SMITH

537.534 : 621.384.6

7308. The proton synchrotron. E. J. LOFGREN. *Science*, **111**, 295-300 (March 24, 1950).

A discussion of the proton-synchrotron under construction at Berkeley. Design considerations, and figures for the full scale 3.7 BeV machine are given, and the performance of the completed quarter-scale model discussed. W. I. B. SMITH

537.534 : 621.384.6

7309. The Amsterdam cyclotron. C. J. BAKKER. *Voordr. K. Inst. Ing.*, **2**, 517-23 (May, 1950) In Dutch.

The 72 in synchro-cyclotron, built by Philips Works, operating with a field strength of 14 000 oersteds produces 30 MeV deuterons and 60 MeV α -particles. The supply frequency is 10^7 c/s, the repetition frequency of the modulating condenser is 2 000 c/s. The mean ion current at the target is 5-10 μ A. Photographs and diagrams of the cyclotron are shown. J. A. FRANKS (R)

537.534 : 621.384.6

7310. Synchrotron radiofrequency system. M. H. DAZEY, J. V. FRANCK, A. C. HELMHOLZ, C. S. NUNAN AND J. M. PETERSON. *Rev. Sci. Instrum.*, **21**, 436-9 (May, 1950).

The r.f. system of the Berkeley synchrotron is described. A.

537.534.72

7311. The entrance slit of the precision mass-spectrograph. H. EWALD. *Z. Naturforsch.*, **5a**, 229 (April, 1950) In German.

A discussion of the conditions to be satisfied for highest resolving power. L. PINCHERLE

537.534.72 : 538.69

7312. Focusing by a magnetic sector field, with consideration of the stray field. W. PLOCH AND W. WALCHER. *Z. Phys.*, **127** (No. 3) 274-88 (1950) In German.

Considers the effect of stray fields on the focusing and dispersion of a magnetic sector field as used in

mass spectrometers. Corrections are derived and tested.

J. THEWLIS

537.534.72 : 621.384.6

7313. A focusing device for the external 350-Mev proton beam of the 184-inch cyclotron at Berkeley. W. K. H. PANOFSKY AND W. R. BAKER. *Rev. Sci. Instrum.*, **21**, 445-7 (May, 1950).

A device has been constructed to focus the external beam of the 184 in cyclotron at Berkeley. The device consists of a cylindrical tube 4 ft long and 3 in in diameter, which contains a longitudinal arc of nearly uniform current density. Such a device will focus any beam of cylindrical symmetry. Owing to its large power requirements the device is applicable only to very short pulsed beams.

A.

537.534.74

7314. Deuteron-proton scattering using photographic techniques. F. A. RODGERS, H. A. LEITER AND P. G. KRUGER. *Phys. Rev.*, **78**, 656-62 (June 15, 1950).

The differential scattering cross-section for 9.94 ± 0.08 MeV deuterons scattered by protons has been determined with nuclear track emulsions as detectors. The deuterons were obtained from the cyclotron while the target consisted of H gas at a pressure of approximately 5 cm Hg. The photographic plates were arranged so that they recorded simultaneously at all laboratory angles from 12.5° to 65° . Approximately 5 000 proton tracks at each of 12 angles in this range were counted. Geometrical, slit scattering, and slit penetration corrections have been made to the number of tracks counted.

A.

537.534.74

7315. Proton-proton scattering at 5 Mev. R. E. MEAGHER. *Phys. Rev.*, **78**, 667-73 (June 15, 1950).

The differential cross-section for the scattering of protons has been measured at an energy of 4.96 ± 0.08 MeV, at angles from 12.5° to 55° in the laboratory system. The scattering medium was H gas at a pressure of approximately 5 cm of Hg. The scattered or recoil protons were detected by nuclear track photographic plates. Approximately 10 000 proton tracks were counted at each angle of observation. An estimate indicates the error of each individual cross-section to be about 2%. Because the observations at each angle are made simultaneously, the relative accuracy from one angle to another is smaller and amounts to about 1.3%.

A.

537.534.74 : 530.145

Interpretation of proton-proton scattering. See Abstr. 7019-20

537.534.75 : 539.164

The range-energy relation for protons in air. See Abstr. 7465

spectroscopy is described. The motion of the needle is obtained through a grease seal instead of through a bellows.

A. H. W. BECK

537.542

7317. On discrimination in mass spectrometer ion sources. G. CARERI AND G. NENCINI. Letter in *J. Chem. Phys.*, **18**, 897-8 (June, 1950).

537.542

7318. The efficiency of the G-M counter. M. SONODA. *J. Phys. Soc. Japan*, **5**, 53-6 (March-April, 1950).

The efficiency, i.e. the counting probability per one quantum, of the thick-walled γ -ray counter was computed theoretically by making some simplifying assumptions for several energies between 10 mc^2 and 34 mc^2 (Li-p γ -ray) and for different wall thickness. The efficiency of the thin-walled counter was also discussed.

A.

537.542 : 539.166.2

Proportional counters in a magnetic field and their calibration. See Abstr. 7478-9

537.542 : 539.185.7

Evaluation of neutron counter efficiency. See Abstr. 7522

537.542 : 621.387.424

7319. Automatic plotting of the plateaux of Geiger-Müller counters. R. WAHL. *J. Phys. Radium*, **11**, 271-2 (June, 1950) In French.

The stabilized h.t. supply to a G.M. counter at a fixed distance from a suitable radioactive source is varied from 60-100% of a chosen potnl. in 15 steps and the counting rate recorded (integrating time const. 13 sec). The counters are changed automatically and are measured at the rate of 10/hr.

A. O. STANESBY

537.542 : 539.166.2

Measurement of gamma-ray energies with one or two crystals. See Abstr. 7480-1

537.542

7320. Liquid scintillation counters. G. T. REYNOLDS. *Nucleonics*, **6**, 68-9 (May, 1950).

The scintillation properties of a number of organic solutions have been examined with Co^{60} γ -rays. The solutions included:—naphthalene and naphthalene + anthracene in benzene; terphenyl in xylene, benzene, toluene and cyclohexane. Best results were obtained with the terphenyl solutions, which gave pulses of slightly less than half the size of those from anthracene crystals. Specially purified terphenyl was not significantly better than the commercial grade. Because of the possibility of obtaining large cells of clear solutions it is expected that these solutions may prove very useful in cosmic ray research.

L. R. SHEPHERD

537.542

7321. Scintillation counting with solutions. H. KALLMANN. Letter in *Phys. Rev.*, **78**, 621-2 (June 1, 1950).

Solutions of fluorescent molecules (carbazole, phenanthrene and anthracene) in toluene, xylene and paraffin scintillate under α , β and n radiation. Output pulses for α and γ rays are $\sim 5 \times$ noise and

DISCHARGE TUBES . COUNTERS 537.54

537.542

7316. An accurately adjustable needle valve for ion sources. H. EWALD. *Z. Naturforsch.*, **5a**, 230-1 (April, 1950) In German.

A precision needle valve vacuum leak for mass

n 15-20 $\times$ noise. Counting efficiencies for n γ -rays appear to be higher than in organic scintals.

G. F. J. GARLICK

537.542 : 539.166

2. Scintillation counting of gamma-rays. W. V. NEYNEORD AND E. H. BELCHER. Letter in *Nature*, **165**, 930-1 (June 10, 1950).

It is shown that observed counting rates of a thallium-crystal/1P21-photomultiplier system for ^{24}Na , Co^{60} and I^{131} gamma-rays have an absolute significance, every gamma-ray being counted at low false discriminations. The multiplier is cooled to liquid air and a Perspex light guide used which introduces negligible counts which must be allowed for.

G. F. J. GARLICK

537.542 : 539.185.08

23. Scintillation counter for neutrons. K.-H. REIN AND W. E. SHOUPP. Note in *Rev. Sci. Instrum.*, **21**, 395-6 (April, 1950).

537.542

24. Some properties of the parallel plate spark counter. II. L. MADANSKY AND R. W. PIDD. *Rev. Sci. Instrum.*, **21**, 407-10 (May, 1950).

The delay error distribution of the parallel plate spark counter has been measured and the average delay found to be 6×10^{-9} sec. The counters are, therefore, applicable to the measurement of lifetimes as short as 10^{-9} sec. Auxiliary circuits, including a fast synchroscope, for short time interval measurements are described, and the resolution limitations of the counters and circuits are discussed.

A.

537.542 : 621.318.572

325. A stable ninety-nine channel pulse amplitude analyser for slow counting. D. H. WILKINSON. *Proc. Camb. Phil. Soc.*, **46** (Pt 3) 508-18 (1950).

A pulse of constant height and length $\propto$ the peak value of the input pulse (rise time 1-50 μsec) is used to gate a continuously running oscillator, and the number of cycles counted by a scale-of-100 and recorded on message registers. The max. recording rate is ~ 10 counts/sec, but higher rates can be accepted, since the pulse-height distribution is unaffected. The calibration is linear, and all channels are of same width; the long-term stability is better than 1%.

A. O. STANESBY

537.542 : 621.318.572

326. High speed electronic scaler. W. M. SESSLER AND A. V. MASKET. Note in *Rev. Sci. Instrum.*, **21**, 94 (May, 1950).

537.542 : 621.318.572 : 621.317.757 : 621.3.018.75

327. A pulse-amplitude analyser of improved design. E. H. COOKE-YARBOROUGH, J. BRADWELL, C. D. FLORIDA AND G. A. HOWELLS. *Proc. Instn. Elect. Engrs*, Pt I, **97**, 108-20 (March, 1950).

The instrument, required for nuclear physics work, is designed to measure part of the amplitude distribution—up to 5 channels—of pulses generated in ionization chambers and the like. Pulses arising from either electron or ion collection are passed to an amplifying and pulse-expanding unit where pulses are

generated whose height is $\propto$ that of the original pulses but whose width is increased sufficiently to facilitate subsequent amplification. This step is necessary because counting accuracy demands a level of ~ 50 V/channel. The amplified pulses then pass to a "ladder" discriminator which routes to separate scalers the pulses falling within each channel range. A waveform generator, driven from the ladder, provides pulses which prevent false triggering of the scalers and ensure correct discharge of storage circuits in the pulse-expander. Automatic d.c. level control, which is sometimes applicable, is also available. The total storage capacity of each scaler is 99 999 counts and the max. counting rate, within the instrument, is 1 000/min/channel. The analyser is intended to form the basis for the design of a 30-channel instrument, adequate for covering the whole of a distribution curve.

H. G. M. SPRATT (R)

537.542 : 621.318.572

7328. A portable Geiger-counter. M. MICHAELIS AND R. O. JENKINS. *Electronic Engng*, **22**, 112-15 (March, 1950).

A self-contained battery-operated equipment, comprising commercial G.-M. tube (G.M. 2 or 4), a.f. power supply, amplifier (for telephones) and counting-rate meter. Range is ~ 50 -80 000 counts/min; accuracy $\sim 5\%$, neglecting random fluctuations.

A. O. STANESBY (R)

537.542 : 621.387.424 : 621.317.39

7329. A survey equipment using low-voltage halogen-quenched Geiger-Müller counters. E. FRANKLIN AND W. R. LOOSEMORE. *Instn. Elect. Engrs*, Paper 1031 (1950) 8 pp.

Describes a small portable equipment for use by the private prospector in the location and approximate assay of radioactive ores. Its features, are cheapness in cost and maintenance, simplicity of operation, long battery-life (2 000 hr), robustness, lightness of weight (6 lb) and smallness of size ($8\frac{1}{2}$ in $\times$ 8 in $\times$ 3 $\frac{1}{2}$ in). A pair of headphones and a meter are supplied as indicators; one quarter of full-scale deflection of the meter denotes the presence of bed rock containing 0.03% uranium oxide (0.003r/h for γ -rays from radium), and full-scale deflection denotes that of 1% uranium oxide (0.018r/h). Cold-cathode valves are used in the instrument, one acting as a constant-amplitude oscillator feeding a miniature Cockcroft-Walton voltage-quadrupler producing a stabilized voltage output. The moulded-plastic container is completely weatherproof. The Geiger-Müller counter tubes use Br as the quenching agent, have thresholds of about 300-330 V, and have very long lives. The range of temperature over which they will operate is from -50°C to $+40^\circ\text{C}$, the temperature coefficient of threshold voltage being less than 0.2 volt/ $^\circ\text{C}$. Plateaux are 100 V in length, with slopes from 0.03-0.1%/V. The counters may be operated at ± 800 V without damage. Their efficiency is not appreciably different from that of standard tubes.

A.

537.542

7330. On the statistics of luminescent counter systems. F. SEITZ AND D. W. MUELLER. *Phys. Rev.*, **78**, 605-12 (June 1, 1950).

The method of generating functions is employed to

analyse the composite statistical variations which arise in a counting system that consists of a source, a luminescent crystal and a photo-multiplier tube. The methods are applied to several photo-type assemblies and indicate that the techniques can be used to treat any problem of this type in a simple way. Once the crystal has accepted energy, the effectiveness of the assembly is measured by the number of photo-electrons ejected from the photo-cathode of the multiplier. This quantity, which depends upon the luminescent efficiency of the crystal, the geometry of the crystal-multiplier arrangement and the efficiency of the photo-cathode, should be at least 5 for faithful counting of particles absorbed in the crystal. The number of photoelectrons must be much larger than 5 for good statistics if the current from the multiplier is measured. The results of Schiff and Evans for the statistical variations in the voltage of a capacitor which is charged with the pulses from the multiplier are generalized to cover the case in which the size of pulses varies. A.

IONIZATION . THERMIONICS 537.56/.58

537.56 : 536.46 : 541.126

7331. Studies on the ionization produced by metallic salts in flames. II. Reactions governed by ionic equilibria in coal-gas/air flames containing alkali metal salts. H. BELCHER AND T. M. SUGDEN. *Proc. Roy. Soc., A*, 202, 17-39 (June 22, 1950).

The ionization produced by adding alkali metal salts to coal-gas/air flames has been studied by measuring the attenuation of 3 cm waves, this attenuation arising from free electrons. In a previous paper [Abstr. 5905 (1950)] the coefficient relating attenuation to electron population has been determined and is used in applying the present results to the problems of chemical equilibrium involving ions in the flames. An examination has been made of the degree of equilibrium obtained in a number of chemical reactions in the flame by varying the electron content, the amount of added alkali metal salt and its nature. Flame temperatures were measured by the Na line-reversal method, considered to be the most suitable for the purpose. In the case of KHCO_3 the results are compatible with chemical equilibrium of the ions if suitable account is taken of other equilibrated reactions involving K hydroxide, oxide and hydroxyl ions. Some evidence of disequilibrium has been observed when K halides are added, where both formation of negative halide ion and halogen acid affect the electron content. This appears to be connected with concentrations of H atoms and hydroxyl groups (chain centres) which diverge from the values expected at equilibrium. Addition of extra free halogen confirms the anomalies. In the case of the chlorides and fluorides, the halogen appears to be completely removed as halogen acid. A comparison of the alkali chlorides on the whole supports the use of the Saha equation relating equilibrium ionization and flame temperature, providing account is taken of side reactions. A.

537.56
7332. The application of photon counters to study of some phenomena of molecular or atomic excitation. M. ADER, J. DEBIESE AND T. KAHN. *C.R. Acad. Sci., Paris*, 230, 2010-11 (June 5, 1950). In French.

A new method for the determination of the ionization and resonance potentials of gases and vapors makes use of a photon counter consisting of a photoelectric multiplier, a scaling counter and related electronic circuits. By this method the following have been studied, or established: de-activation as a function of time; ionization potentials of N_2 and O; analysis of gases under low pressures; the life of excited atoms in the metastable state. W. SUMMERS.

537.58 : 621.385 : 621.316.721.0

7333. Automatic regulation of thermionic emission. W. STECKELMACHER AND S. VAN DER MEER. *J. Sci. Instrum.*, 27, 189-91 (July, 1950).

A circuit is described which automatically controls the emission of thermionic devices for large changes of emission characteristics, and is also independent of large mains voltage fluctuations. The power required to heat the emissive surface is controlled by two valves which have the two primary windings of the filament transformer as their load. Part of the electron current to be stabilized is used to control the two valves via a pre-amplifier, so that an increase in emission will reduce the current passed by the valves and thus the filament current. A phase-shift network is used to obtain high stabilization ratios without setting up oscillations in the feedback network when controlling massive filaments. A circuit is given applying these principles to the emission control of an ionization gauge in which the grid current is kept constant to within 0.5% under all conditions.

537.581 : 537.311.3

On the noise spectra of semi-conductor noise and flicker effect. See Abstr. 7244

537.58

7334. On the interpretation of conduction and thermionic emission of (Ba-Sr)O cathodes. F. K. DU PRÉ, R. A. HUTNER AND E. S. RITTNER. *Phys. Rev.*, 78, 567-71 (June 1, 1950).

A new semiconductor model for (Ba-Sr)O cathodes is proposed comprising a conduction band, donor levels, acceptor levels and a full band. The combination of this model with the concept of conduction by an electron gas in the pores of the oxide coating appears to explain many of the experimental facts. Some predictions which follow from this picture are indicated. A.

537.583

7335. A suggestion regarding the spectral density of flicker noise. F. K. DU PRÉ. Letter in *Phys. Rev.*, 78, 615 (June, 1950).

It is shown that Schottky's original theory of flicker noise can be given a temperature- and frequency-dependence in agreement with experiment by supposing that the diffusional activation energy varies over the surface so that the proportion of surface with Q in the range dQ at Q is $f(Q) \cdot dQ$. If $f(Q)$ varies little in a range of the order kT the result is $i^2 \propto$

$(\omega)Tf[-kT \ln(\gamma_0\omega)]$. The desired ω^{-1} variation obtained if $f(Q)$ is independent of Q . Variations of Q of about 0.25 eV would account for the observed fluxes.

A. H. W. BECK

537.583 : 537.534 : 536.422.1

36. Mass spectrometric study of solids. I. Preliminary study of sublimation characteristics of oxide cathode materials. R. H. PLUMLEE AND L. P. SMITH. *Appl. Phys.*, 21, 811-19 (Aug., 1950).

Mass spectrometric techniques have been utilized to study sublimation characteristics of materials used in electron tubes. Exploratory experiments and methods are described. Preliminary results concerning general processes induced by heat and by electron bombardment are discussed. Photographs are shown of mass spectrometer traces which demonstrate the effects described. Phenomena noted include: (1) the inefficiency of electron bombardment for producing material transport from solids; (2) the thermal evaporation of alkali metal atoms and ions from bare Ni alloys, but no such evaporation from oxide cathodes formed on the same materials; (3) the complex thermal evaporation of oxide cathode constituents; (4) absence of positive ion evaporation from oxide cathodes; (5) the confirmation of mechanisms for negative ion formation in vacuum systems; and (6) the liberation of molecular oxygen from oxide cathodes which increases with electron emission drawn.

A.

COSMIC RAYS 537.591

537.591 : 523.165

7337. Cosmic radiation and radio stars. H. ALFVÉN AND N. HERLOFSON. Letter in *Phys. Rev.*, 78, 616 (June 1, 1950).

Following the theory that cosmic rays near the solar system are confined by a solar "trapping field" to a region with dimensions of about 1/10 light year [Abstr. 2579 (1950)], it is suggested that every star has such a region of similar size, and that the radio star emission is produced by cosmic-ray electrons in the trapping-fields of stars with low visual luminosities moving rapidly relative to interstellar clouds.

M. W. OVENDEN

537.591.1

7338. On the measurement of the mass of cosmic ray particles using a sandwich of photographic plates in a magnetic field. Y. GOLDSCHMIDT-CLERMONT AND M. MERLIN. *Nuovo Cim.*, 7, 220-9 (May, 1950) *In Italian*.

Sandwiches of photographic plates with emulsions facing each other at a distance of 1.5 mm were exposed in a magnetic field of 30 000 gauss at sea level. The relative position of the plates was determined by a grid of the marks produced by a thin pencil of X-rays. During the preparation, exposure and processing the greatest care was taken to ensure to the plates their maximum sensitivity, and to avoid distortion of the gelatine. The radius of curvature of the track in the magnetic field, during the flight between the emulsions, is determined from the relative

direction and position of the tangents at the impact points in the emulsions. When the particle ends in one of the emulsions, this measurement of momentum can be combined with a measurement of range, to calculate the mass as stated by Powell and Rosenblum. When the particle passes through the two emulsions, the measurement of momentum can be combined with a measurement of grain density, in the region of energies where this parameter is sufficiently sensitive, or with a measurement of scattering, when the length of track available for measurement is sufficient.

A.

537.591.1

7339. Nucleonic components of cosmic radiation at medium energies. P. BUDINI AND N. DALLAPORTA. *Nuovo Cim.*, 7, 230-54 (May, 1950) *In Italian*.

The authors discuss the development of the nucleonic component of cosmic rays in air. It is assumed that it is generated by, and still partly composed of, the primary nucleons which interact with the nucleons of the air, and that the differential cross-section both for the energy loss of nucleons and for the expulsion of the secondary nucleons from the air nuclei, is of the bremsstrahlung type. Account is taken of the energy loss caused by slowing down in nuclear matter, and of energy loss caused by ionization produced by nucleons which are in proton state. Taking into account this loss of energy and the probability that a nucleon has travelled a certain part of its path as a proton and the rest as a neutron, a calculation is made to ascertain the ratio of protonic and nucleonic components. The limits of validity of the method are discussed and the results are compared with the experimental data.

A.

537.591.1 : 539.18

Magnetic deflection of cosmic-ray mesons using magnetic plates. See Abstr. 7511

537.591.15

7340. Further investigations on the plural production of meson showers. W. HEITLER AND L. JÁNOSSY. *Helv. Phys. Acta*, 23 (No. 4) 417-31 (1950) *In German*.

Calculations on the size of nucleon-initiated meson showers have been extended by including secondary effects of recoil nucleons. It is shown that showers with up to 30 or 40 mesons occur still with reasonable probability in the picture of plural production. The protons accompanying the shower and the angular distribution are discussed. The production of showers by π -mesons is considered. Assuming that these are primarily due to the scattering of the meson by a nucleon it is shown that for high meson energies meson showers are produced. The cross-section is estimated to be 0.4-0.9 of the geometrical cross-section for heavy elements, and the most important energies. It is found that all the conspicuous features of penetrating showers can be understood by the picture of plural production.

A.

537.591.15

7341. The lateral distribution of particles in extensive cosmic ray showers in air. C. MILONE, S. TAMBURINO AND G. VILLARI. *Nuovo Cim.*, 7, 207-19 (May, 1950) *In Italian*.

G.M. counter measurements at 35 m have been made at Catania to study the lateral distribution of

penetrating particles in extensive cosmic ray air showers and compare it with that of the electrons. The following results have been obtained: (1) the ratio of penetrating particles to electrons is about 3% in the central section of the shower, and seems not to change when the mean density in this side varies from 35 to 105 m⁻²; (2) by selecting showers having a mean density in the central section of 35 particles m⁻², it has been found that the ratio of R_p (density of penetrating particles at distance r from "shower axis") to R_e (density of electrons at distance r from "shower axis") increases slowly with r but changes only by a factor, i.e. between $r = 0$ and $r = 50$ m. A.

537.591.15

7342. On the dependence on depth of the spreading of the electrons of an air shower. II. A. BORSELLINO. *Nuovo Cim.*, 7 (No. 3 bis) 323-30 (May, 1950) In Italian.

Enlarges and completes the result of a previous paper [see Abstr. 4179 (1950)], obtaining, by means of a Laplace transformation, the same results obtained by other authors by different methods. It shows in particular that, for electrons of a given energy, the spreading increases with depth. L. PINCHERLE

537.591.15

7343. On the nature of the penetrating particles in the electron-nuclear showers. N. BIRGER, G. ZHDANOV, V. POLYNOV AND S. SLAVATINSKIĬ. Letter in *J. Exp. Theor. Phys.*, USSR, 20, 478-9 (May, 1950) In Russian.

There are only scarce data on the character of the penetrating component of the electron-nuclear showers in the literature. The contribution of the authors was obtained with a Wilson chamber in a magnetic field of 13 000 Gauss and hodoscopic rows of counters under 3-4 cm Pb. The data collected show a prevalence of protons among the penetrating particles of energies $\leq 1.3 \times 10^9$ eV, and some probable cases of particles of either sign with masses $< m_p$. B. F. KRAUS

537.591.15

7344. A hodoscope study of penetrating cosmic-ray showers. I. Local showers. K. SITTE. *Phys. Rev.*, 78, 714-20 (June 15, 1950).

Showers produced locally in a Pb absorber were studied. It is shown that, in order to record "local penetrating showers," a rigid selection demanding high penetrating power of the secondaries as well as of the primary must be used. If this is done, some of the discrepancies of recent investigations are removed. For showers capable of penetrating at least 200 g/cm² Pb one finds a collision mean free path of (162 ± 10) g/cm², and for showers of at least 100 g/cm² penetration a mean free path of (196 ± 13) g/cm². Besides, "local soft showers" due to electronic or photonic secondaries of ordinary μ -mesons were studied. Their frequency at 3 260 m elevation is about 1 in 10³ traversals of the Pb absorber. A.

537.591.15

7345. A hodoscope study of penetrating cosmic-ray showers. II. Extensive showers. K. SITTE. *Phys. Rev.*, 78, 721-6 (June 15, 1950).

The interactions of penetrating particles have been

studied at an altitude of 3 260 m. About 90% of a charged penetrating particles do not originate local showers of penetrating secondaries, and are absorbed only very slowly. This "non-interacting component," consisting at least predominantly of μ -mesons, has a rather flat range spectrum between 280 and 680 g/cm² Pb. Its zenith angle distribution is approximated proportional to $\cos^4 \theta$. The remaining 10% constitute a "charged N component"; the total fast component amounts to about one-fourth of the number of the charged penetrating particles. The collision mean free path of the fast N component was found to be (220 ± 30) g/cm² if a minimum of 100 g/cm² penetration is demanded for the local showers. From the recorded increase of the number of shower particles with absorber thickness it is concluded that further multiplication after the first collision is quite common, and that the mean free path of the secondaries of local showers is not much larger than that of the primary N component.

537.591.

7346. Energy transfer to nucleons in cosmic-ray stars at 95 000 feet. H. L. BRADT AND M. F. KAPLAN. *Phys. Rev.*, 78, 680-2 (June 15, 1950).

The size-frequency distribution of cosmic-ray stars produced in photographic emulsions exposed at 95 000 ft altitude and the energies associated with the non-relativistic prongs of these stars have been determined. A distribution function for the excitation energy of stars with more than 8 prongs is derived. A.

537.591.15

7347. Measurement of high altitude vertical cosmic-ray intensity, at New Delhi, India, 19° north, geomagnetic latitude. G. S. GOKHALE, A. S. RAO AND R. P. THATTE. *Proc. Indian Acad. Sci.*, A, 30, 184-204 (Oct., 1949).

Using the radio-sonde technique, 3 high altitude balloon flights were made at New Delhi 19° N (Mag.) to measure the total vertical intensity to heights up to 40 000 ft (200 mb). It has been found that the intensity v . pressure curve for the total intensity as reported by other workers is well represented by a 3rd degree polynomial of the log (intensity) against log (pressure). There is good agreement between the 3 flights when normalized to the same reading at ground level, and the results are well represented by the same polynomial. There is a renewed indication of a hump and a depression in the regions previously reported by Bhabha and co-workers and Gill in their aeroplane ascents, and this cannot be attributed to temperature effect here since the temperature was very well controlled inside the gondola by the "green-house" effect. A.

537.591.5

7348. The problem of meson generation and the effect of latitude. M. F. SFORZINI. *Nuovo Cim.*, 7, 196-206 (May, 1950) In Italian.

The number $\Lambda(W, \lambda, E)$ of mesons which arrive, at sea-level from all possible directions, and which have been generated with an energy E by a nucleon of energy W at a latitude λ , has been calculated. Using this number, which is independent of any particular hypothesis of meson production, the total

ensity of meson radiation at sea-level has been calculated as a function of the latitude, using the ataghin hypothesis of production. Experimental sults are compared with the results of calculation. A.

537.591.5

349. **The barometric effect in extensive air showers.** CASTAGNOLI, A. GIGLI AND S. SCIUTI. *Nuovo Cim.*, (No. 3 bis) 307-12 (May, 1950) *In Italian*.

The results of correlation measurements between extensive showers and atmospheric pressure at 500 m above sea-level are reported. The barometric coefficients obtained are 9.8% — 10.6% for a 4.7 m base and 9.2% — 9.7% for a 6.0 m base. A.

537.591.5

350. **Correlation of geomagnetic cosmic-ray effects.** I. V. NEHER. *Phys. Rev.*, **78**, 674-80 (June 15, 1950).

With the experimental data collected in a B-29 aeroplane and given in an earlier report, an attempt is here made to correlate several of the well-known geomagnetic effects found in cosmic rays. First, evidence is presented to show that, within the uncertainties of the experimental data and the existing calculations on the behaviour of charged particles in the magnetic field of the earth, there are few if any negative primary particles in the momentum range 7 to 23 BeV/Zc compared with positives. Second, under the assumption of no primary negative particles and by correlating experimental data on the latitude effect at different zenith angles with the zenith angle effect in the east-west plane at the equator, it is possible, with the help of calculations of Vallarta *et al.* at the equator, to determine curves of minimum momentum for the primaries as a function of geomagnetic latitude. It is thus possible to plot curves for intermediate latitudes where the calculations are extremely difficult and have not been carried through in detail except in certain special cases. The results are independent of any assumed momentum distribution of, or the magnitude of charge carried by the primary particles. A.

537.591.8

7351. **Stars and single tracks in nuclear plates.** H. J. TAYLOR, H. J. BHABHA, R. R. DANIEL, J. R. HEERAMANECK, M. S. SWAMI AND G. S. SHRIKANTIA. *Proc. Indian Acad. Sci., A*, **31**, 130-9 (Feb., 1950).

Photographic plates exposed at high altitudes show a population of stars and isolated single tracks. Statistics are given covering 288 stars and 655 isolated tracks found in an area of 17 cm². Some tracks are closely associated with the stars, and these have a mean range of 4.1 cm air. The remainder, which show no association with stars, have a mean range of 3.4 cm air. Some stars have more than one associated single track. Alternative explanations are discussed. The most probable hypothesis appears to be that the single tracks are due to the spontaneous disintegration of unstable neutral particles emitted from the stars. A.

537.591.8

7352. **Evidence from cosmic-ray bursts for a nuclear cascade process.** G. N. WHYTE. Letter in *Phys. Rev.*, **78**, 630 (June 1, 1950).

537.591.8 : 539.18

7353. **Nuclear transmutations produced by cosmic-ray particles of great energy. V. The neutral mesons.** A. G. CARLSON, J. E. HOOPER AND D. T. KING. *Phil. Mag.*, **41**, 701-24 (July, 1950).

The spectrum of the γ -radiation in the atmosphere at 70 000 ft has been determined by observations on the scattering of pairs of fast electrons recorded in photographic emulsions exposed in high-flying balloons. The detailed form of the spectrum is consistent with the assumption that the γ -rays originate by the decay of neutral mesons. It is found that the mass of the neutral mesons is $295 \pm 20 m_e$, and that they are created in nuclear explosions with an "energy spectrum" similar to that of the charged π -particles. A method is described for determining the lifetime of the neutral mesons and their frequency of occurrence compared with charged π -particles. The lifetime, τ_{π_0} , is less than 5×10^{-14} sec. It may be possible to determine the lifetime, by observations of greater statistical weight, if it is longer than 2×10^{-14} sec. The ratio of the number of neutral mesons to charged mesons, produced in nuclear explosions of great energy, is equal to 0.45 ± 0.10 . A.

537.591.8 : 539.185

7354. **Neutron production by complete absorption of high-energy photons.** J. S. LEVINGER. *Nucleonics*, **6**, 64-7 (May, 1950).

A high-energy photon incident on a block of material produces lower energy photons in shower processes. An expression is derived for the yield of neutrons (in photodisintegrations produced by shower photons) when high-energy photons are incident on a thick Pb block. The yield is proportional to the incident photon energy and is shown to be $\sim 2\%$ for a 100 MeV photon. In other elements the yield varies roughly as $Z^{1/2}$. Neutron yields from thick and thin absorbers are also derived for the case of incident photons having a bremsstrahlung spectrum. L. R. SHEPHERD

MAGNETISM 538

538.1 : 538.22

7355. **Ground state splittings in the iron group, particularly cobaltous ion. The operation of Kramer's rule.** J. J. FRITZ. Letter in *J. Chem. Phys.*, **18**, 760-1 (May, 1950).

Results of measurements on $\text{CoSO}_4 \cdot 7\text{H}_2\text{O}$ at low temperatures [Abstr. 5570 (1949)] are considered in relation to Schlapp and Penney's theory, which, it is suggested, has over-estimated the effect of spin-orbit coupling on energy level splitting and in increasing χ at higher temperatures. Curves for χ similar to Schlapp and Penney's are obtainable by considering for Co^{++} a 4-fold degenerate level with $L = 0$ as ground state and a similar higher level with $L = 1$, without interaction and with a separation much less than that assumed in the theory. Co^{++} should show Kramer's degeneracy, but theory requires 2-fold rather than 4-fold degeneracy postulated here.

E. P. WOHLFARTH

538.114 : 530.162 : 539.11

Statistics of solid solutions and ferromagnetism.
See Abstr. 7401

538.213

7356. Time decrease of magnetic permeability in alnico. R. STREET AND J. C. WOOLLEY. *Proc. Phys. Soc., Lond., B*, **63**, 509-19 (July, 1950).

The formal theory, based on the concept of thermal activation of domain processes, previously proposed to account for the phenomenon of magnetic viscosity, has been extended to describe time decrease of permeability. Within certain limits the predictions of the theoretical analysis are verified by measurements made on time decrease of permeability using an alnico rod specimen. It is shown that the quantitative results of these measurements are in good agreement with those obtained from the magnetic viscosity experiments. The possible physical mechanisms responsible for both magnetic viscosity and time decrease of permeability in alnico are discussed. A.

538.214

7357. On the law of approach to saturation for martensite. N. S. AKULOV AND K. M. BOLSHOVA. *Dokl. Akad. Nauk, SSSR*, **71** (No. 4) 633-6 (1950) *In Russian*.

The theory is expanded to: (a) non-eutectic solid solutions where strong, sharply non-homogeneous local stresses are possible; (b) heterogeneous alloys. The relevant formulae, graphs and full experimental procedure are given. A new method for the measurement of the differential susceptibility utilizing alternating magnetic field was used. The tested specimen served as core of transformer the output from which was fed to an amplifier resulting in higher sensitivity. The differential susceptibilities of 4 kinds of steel with carbonous content 0.49, 0.75, 1.03, 1.12% respectively were measured over a field 600-1 500 oersted. Z. F. WOJNAR

538.214 : 536.48

7358. Magnetic susceptibilities of iron group salts at low temperatures. A. F. JOHNSON AND H. GRAYSON-SMITH. *Canad. J. Res., A*, **28**, 229-41 (May, 1950).

A magnetic balance of the Sucksmith ring type has been constructed. It is capable of a precision of 0.5 to 1% in measurements of displacement. The estimated maximum error in susceptibility measurements is 2%. This apparatus has been used to measure the temperature variation of the susceptibilities of Cr sulphate, hydrated and anhydrous, and of the nitrates of Cr, Co and Ni. Measurements were made at several values of the magnetic field strength, so that a correction for small amounts of ferromagnetic impurity could be obtained. The reciprocals of the corrected specific susceptibilities were plotted against the absolute temperature. The intercepts on the temperature axis of the resulting straight lines gave the values of the Curie-Weiss constant. These values have been compared with those for other salts of the same ions. The effective Bohr magneton numbers were calculated and compared with theoretical values given by van Vleck. A.

538.22

7359. The magnetic properties of uranium and

uranium-iron alloys. L. F. BATES AND J. R. MALLARD. *Proc. Phys. Soc., Lond., B*, **63**, 520-6 (July, 1950).

Measurements have been made of the magnetic susceptibility of fairly pure U and of 5 and 10 atomic % alloys of Fe with U. Using a modification of the Curie method, with special pole-pieces and electro-magnetic dynamometer control, the specimens were found to be paramagnetic with no trace of ferromagnetism in the temperature range 20° to 350°C. At 20°C the susceptibility of pure U is $+1.740 \times 10^{-6}$ e.m.u. per g. increasing to $+1.804 \times 10^{-6}$ at 350°C; the results fit the equation $\chi_U = 32 \times 10^{-11} T - 1.564 \times 10^{-6} + 24.0 \times 10^{-6}/T$. Assuming that the Fe is present in form of the compound U_6Fe , it is found that the latter has a susceptibility of $+2.036 \times 10^{-6}$ e.m.u. per g. at 20°C, which remains practically constant with temperature. A.

538.222

7360. Temperature influence on the magnetic characteristics of high-chrome steel. F. M. GALPERIN AND T. M. PEREKALINA. *J. Tech. Phys., USSR*, **20**, 193-202 (Feb., 1950) *In Russian*.

538.221

7361. On the ferromagnetic resonance in nickel and supermalloy. N. BLOEMBERGEN. *Phys. Rev.*, **78**, 572-80 (June 1, 1950).

Both the real and imaginary part of the high-frequency permeability of flat specimens of Ni and supermalloy have been investigated at 9 030 and 24 400 Mc/s, with a constant field H_0 parallel to the plane of the specimen. For the higher frequency experiments were extended beyond the Curie point. The g-factor is independent of temperature within the limit of error; $g = 2.12$ for supermalloy and $g = 2.20$ for Ni. Data are provided on line width and its variation with temperature and compared with existing theories. Only interactions of the ferromagnetic spins with the lattice vibrations or the conduction electrons could probably account for the observed order of magnitude of the width. It is not clear, however, how the width could be independent over a large temperature interval, if these interactions were the only broadening agent. A pseudo-dipolar interaction might give an explanation for the line width at lower temperatures. A.

538.222

7362. Microwave methods in physics. II. Microwave absorption in paramagnetic substances. C. KIKUCHI AND R. D. SPENCE. *Amer. J. Phys.*, **18**, 167-82 (April, 1950).—See also Abstr. 4656 (1949).

538.23

7363. Magnetic hysteresis loss in silicon iron. Intervals of validity of the [empirical] Steinmetz, Richter and Brailsford formulae. V. SÁNCHEZ-GIRÓN NÚÑEZ. *An. Real Soc. Esp. Fis. y Quím.*, **46 A**, 25-36 (Jan.-Feb., 1950) *In Spanish*.

538.24

7364. Magnetic viscosity and part played by displacement of boundaries between domains in a process of remagnetization of highly-coercive alloys. N. BULGAKOV AND E. KONDORSKIĬ. *Dokl. Akad. Nauk, SSSR*, **69** (No. 3) 325-8 (1949) *In Russian*.

Magnetic viscosity manifested itself in the time lag

pen the increase of a magnetic field and the ant magnetization. The investigated alloys Ni 24%, Al 12%, Cu 1.5%, Fe remaining, and 3% Al 8%, Cu 3%, Co 24%, Fe remaining. The experiments disprove recent propositions that in highly pure alloys one process of rotation takes place and that the displacement of domains is absent. Measurements were made over a range of temperatures. After the change of field a device registering change in magnetization was switched in the electric coil of the element; the time was varied between 2×10^{-3} and 81 sec. Full experimental procedure and discussion on the growth of nuclei with various values of field are given. Z. F. WOJNAR

538.24

5. Preferred domain orientation in permanent magnet alloys. M. McCAIG. Letter in *Nature, Lond.*, **1969** (June 17, 1950).

538.24

6. The Barkhausen effect. R. S. TEBBLE, I. C. MORE AND W. D. CORNER. *Proc. Phys. Soc., Lond., A*, **63**, 739-61 (July, 1950).

Further experiments on the Barkhausen effect in cylindrical ferromagnetic specimens are described [Abstr. 1280 (1948)]. The form of the decay of induction following a Barkhausen discontinuity has been investigated and there is reasonable agreement between the theory given and the experimental results. As a result it has been possible to satisfy the different conditions which are necessary for the detection of discontinuities so as to obtain (a) accurate reproduction of the form of the discontinuities and (b) maximum sensitivity in the counting experiments. The number and size of the discontinuities are measured, and an estimate is made of the contribution of the discontinuous processes to the total change in magnetization over the relevant part of the hysteresis curve. Discontinuous changes in magnetic moment greater than 0.3×10^{-6} e.m.u. (corresponding to a minimum volume of 0.9×10^{-10} cm³ for Fe) account for from 47% to 86% of the total change in magnetization. This is considered in relation to associated work on reversible changes, and the nature of a Barkhausen discontinuity is briefly discussed with reference to other investigations on domain structure. A.

538.24 : 548.55

67. Domain wall movement in a single crystal. H. STEWART. *Proc. Phys. Soc., Lond., A*, **63**, 1-5 (July, 1950).

A single crystal of silicon-iron was shaped so as to encourage the formation of large ferromagnetic domains. Its magnetization curve was found to contain a large Barkhausen jump, indicating reversal of magnetization in a volume of the order of $1/10$ cm³. The rate of change of magnetization was found to be proportional to the excess of the applied magnetic field over a certain critical field, and could be made very slow. It is suggested that the rate of change is controlled by the braking effect of eddy currents on the movement of domain walls. A

538.244.2

68. Design and operation of liquid nitrogen-cooled

solenoid magnets. J. J. FRITZ AND H. L. JOHNSTON. *Rev. Sci. Instrum.*, **21**, 416-20 (May, 1950).

Construction details and performance data are given for 2 such magnets, which produce a magnetic field of 4 000 gauss with a power expenditure of 2.7 to 3.3 kW. Heat transfer coefficients between Cu wire and boiling liquid N have been measured for temperature differences between the wire and the liquid of 2 to 11°K. A

538.244.2 : 621.318.3

7369. An improved three-coil system for producing a uniform magnetic field. J. R. BARKER. *J. Sci. Instrum.*, **27**, 197-9 (July, 1950).

A system of 3 coaxial coils for producing a large region of uniform magnetic field is described. The coil formers are all alike, and the outer coils are both wound with twice as many layers of turns as the central coil. All 3 coils are connected in series—an advantage over the author's earlier three-coil system [Abstr. 6336 (1949)]. Design data, and an example of its use, are given. A.

ELECTROMAGNETISM . ELECTRODYNAMICS 538.3/5

538.3 : 530.14 : 621.385.833

7370. Electron motion in alternating magnetic fields. A. KNESCHKE. *Arch. elekt. Übertragung*, **4**, 165-72 (May, 1950) In German.

After complete integration of the differential equations for the motion of an electron in a magnetic field given by $H_0 + H \cos \omega t$, the geometric and dynamical properties of the electron paths are investigated and correlated with curves, whose curvature is a periodic function of arc length. Some physically remarkable cases of the general trajectory are analysed in detail and interpreted geometrically. A.

538.55 : 536.73 : 621.314.63

7371. Can the rectifier become a thermodynamical demon? L. BRILLOUIN. Letter in *Phys. Rev.*, **78**, 627-8 (June 1, 1950).

538.552 : 621.317.373

7372. Measurement of phase-angle between fundamental components of two non-sinusoidal periodic waves. P.-C. FENG. *Chin. J. Phys.*, **7**, 258-64 (April, 1949).

If the two waves are electrical, their voltages are applied, either directly or through a voltage divider, to the two pairs of deflecting plates of a c.r.o. In the case of non-electrical waves, voltages are derived by means of some transducer such as a piezoelectric crystal, photocell or microphone, and applied, after amplification, to the c.r.o. The required phase angle is obtained from a simple formula involving the area of the Lissajous figure on the c.r.o. screen. The formula becomes still simpler if one voltage is sinusoidal. Examples are given of its application to the determination of the phase relations between the grid and anode voltages of an amplifier or an oscillator.

A. WILKINSON (R)

538.56 : 530.131

7373. The second integral of the law-of-conservation type for electromagnetic fields. D. M. VOLKOV. *Dokl. Akad. Nauk, SSSR*, 72 (No. 2) 259-60 (1950). In Russian.

An examination of complete reflection of electromagnetic waves which spread in a finite vacuum of any shape, bounded by a metallic surface of ideal transmissivity. Apart from the classical energy integral ϵ_1 a 2nd integral ϵ_2 is established, independent of time, which also occurs in linear problems of dynamic theory of elasticity and in boundary problems of wave equations.

J. JACOBS

538.56 : 535.42

7374. Diffraction by a plane screen. E. T. COPSON. *Proc. Roy. Soc., A*, 202, 277-84 (July 7, 1950).

The integral-equation method of solving the problem of the diffraction of electromagnetic waves by a perfectly conducting plane screen has been criticized by C. J. Bouwkamp, who claims that it is valid only when certain boundary conditions are satisfied on the edge of the screen. This criticism is answered. It is also shown that, since the equations to be solved are differential-integral equations, an arbitrary function arises in the solution and that this arbitrary function may be chosen so that, although there are singularities at the edge of the screen, there is no radiation of energy from the edge. As an illustration, the 3-dimensional problem of diffraction by a half-plane is solved.

A.

538.56 : 535.42 : 621.396.67

7375. A more exact Fresnel field diffraction relation. G. A. WOOTTON. *Canad. J. Res., A*, 28, 120-6 (March, 1950).

Diffraction relations developed for optical purposes can generally be applied to predict electromagnetic fields due to radiating apertures but, since many radio-optical measurements must be made too close to the aperture for the mathematical approximations in the Fresnel field relation to be valid, new relations, free from these approximations, must be developed. The optical, Fraunhofer relation predicts the distant field with good accuracy and for this reason the Fresnel field is calculated from the distant field equation by the Fourier transform method. An integral results which reduces to Fresnel's integral when the standard optical approximations are made in it. This integral has not been evaluated.

A.

538.561 : 551.594.5

On the origin of the ten centimeter radiation from the polar aurora. See Abstr. 7660.

538.565 : 621.396.611.4

7376. On the representation of the complete system of resonances of arbitrary cylindrical cavity resonators with horizontal stratification of the dielectric medium. E. LEDINEGG AND P. URBAN. *Acta. Phys. Austriaca*, 3 (No. 4) 320-41 (1950) In German.

It is shown that, as in a resonator with only a single dielectric constant, the fields are either T.E. or T.M. The T.E.M. modes occur if the section of the resonator is multiply connected. General expressions for the fields are given. The case of a dielectric constant

which varies over the section in such a way that the second derivative is continuous is applied to a continuous boundary between two media, by Fourier analysis. The expressions for the last case are given in some detail because of their utility in dielectric measurements.

A. H. W. E.

538.565.5 : 621.396.611.3 : 621.33

7377. Principles of measurements on coupled circuits. W. F. DILL. *Philips Res. Rep.*, 5, 91-115 (April, 1950).

An analysis is given of an electric circuit consisting of a valve and two coupled circuits, the coupling of which is capacitive as well as inductive and resistive. The behaviour of this circuit is characterized by its resonance curve and the gain at the central frequency. The conditions for symmetrical resonance curves are investigated. A survey is given of common methods for measuring characteristic quantities, such as coupling factors and qualities of the circuits. New methods are discussed which are practically free from the difficulty of disturbing the normal operating conditions of the circuits, thereby affecting the accuracy of the measurement. These methods enable all characteristic quantities of a system of coupled circuits having a symmetrical resonance curve to be measured.

538.5

7378. Exact theory of the diffraction of a plane electromagnetic wave by a perfectly conducting disk or by a circular opening in a perfectly conducting plane screen. J. MEIXNER AND W. ANDRZEJSKI. *Ann. Phys. Lpz.*, 7, (No. 3-4), 157-68 (1950) In German.

The Hertz vector is developed in a series of spheroidal functions and a unique solution is found satisfying (a) Maxwell's equations; (b) $E_{\text{tang.}} = 0$ on conductors; (c) the radiation condition; (d) boundary conditions on the edges: the fields of the diffracted wave must become infinite in such a way that the integral of the energy density remains finite in a region. Convergence is good for $\lambda > 0$. (r = radius of disk). The case of normal incidence and long waves is treated in more detail.

538.5

7379. On the focusing of a wave. J.-C. SIMEON. *C.R. Acad. Sci., Paris*, 230, 1513-14 (April 24, 1950) In French.

A plate with a number of apertures or its complementary screen have focusing properties. Their focal length is proportional to the wavelength. As they are obviously anisotropic, a complete analogy cannot be made only with crystalline media.

L. PINCHERLE

538.5

7380. Solution of a general problem of applied electrodynamics. R. G. MIRIMANOV. *Dokl. Akad. Nauk, SSSR*, 71 (No. 5) 879-82 (1950) In Russian.

The assumptions are that in an infinite homogeneous medium containing a field variable in time according to $\exp(j\omega t)$, there are embedded bodies of any form in a non-symmetrical arrangement (a field of non-zero sources and vortices). As is well known, this case leads to the vectors $\vec{E}$ and $\vec{H}$ having to satisfy non-homogeneous wave equations, the homogeneous

forms of which are solved by Green's theorem. The resultant integro-differential equation is treated by expansion in terms of a small parameter, and it is shown that the solution (even when only the initial term of the expansion is considered) is good enough to treat diffraction problems in dm- and cm-wave technique, as e.g. arising in connection with non-symmetrical aerials of various types. B. F. KRAUS

538.566 : 535.42 : 621.396.11

7381. On the diffraction of a radar wave by a conducting wedge. R. B. WATSON AND C. W. HORTON. *J. Appl. Phys.*, 21, 802-4 (Aug., 1950).

Diffraction patterns of radar waves have been measured about the edge of a perfectly conducting wedge. Theoretical patterns have been calculated using an asymptotic solution suggested by Pauli. Good agreement is observed between experimental and calculated patterns. The thin wedge tested showed much similarity in diffracting properties to a suitable semi-infinite conducting screen. The results may have application to diffraction effects about wedge-shaped wings on high speed aircraft and missiles. A.

538.566 : 535.42 : 621.396.677

7382. The effect of an obstacle in the Fresnel field on the distant field of a linear radiator. G. A. WOONTON. *J. Appl. Phys.*, 21, 577-80 (June, 1950).

At radio wavelengths the use of mirrors and lenses in the measurement of radiators, by methods which are customary in physical optics, is possible only if errors, due to incidental diffraction from the relatively small apertures of such apparatus, can be corrected by calculation. Theory is developed from which these calculations can be derived for linear radiators. A new relation which expresses the Fresnel field in terms of the distant field is fundamental to the method. Satisfactory agreement has been obtained between the predicted and measured distant fields of several electromagnetic horns whose near fields were obstructed; the details of the experiment are not reported. A.

538.566 : 535.421

7383. Diffraction pattern in a circular aperture measured in the microwave region. C. L. ANDREWS. *J. Appl. Phys.*, 21, 761-7 (Aug., 1950).

Measurements were made of the diffraction patterns of circular apertures from one to eight wavelengths in diameter in the planes of the apertures and in the neighbourhood of the apertures when a plane-polarized electromagnetic wave was incident upon them. The positions of maximum intensity have been predicted in the neighbourhood of the aperture on Thomas Young's theory and the values of the intensities over the apertures checked with experiment. A.

538.566 : 537.533.3 : 621.385.1.029.6

7384. Wave propagation in a slipping stream of electrons: small amplitude theory. G. G. MACFARLANE AND H. G. HAY. *Proc. Phys. Soc., Lond. B*, 63, 409-27 (June, 1950).

A theoretical study is presented of the TM-waves

that can travel along a slipping stream of electrons. A slipping stream is defined as one in which the electrons move in parallel paths with velocity which varies with distance transverse to the motion. It is found that amplifying waves can travel along a slipping stream for all frequencies. It is also found that the slipping-stream tube has the remarkable property of combining the characteristics of a 2-beam tube and a travelling-wave tube. This is due to the occurrence in the stream under suitable conditions of resonance layers, which act as highly reactive impedance sheets and can guide TM-waves of slow phase velocity in the same way as the spiral or corrugated surface in a travelling-wave tube. Wave propagation along a slipping stream inside a waveguide, which in the absence of the electrons can guide a TM-wave of slow phase velocity, is also discussed. It is shown that this slipping stream travelling-wave tube has very much the same characteristics as a travelling-wave tube with a uniform electron beam. A.

538.566 : 551.510.535 : 621.396.11

7385. The passage of electromagnetic waves through the ionosphere. L. KOŁODZIEJCZYK. *Soc. Sci. Lodz., Sect. III (No. 6) 26 pp.* (1948).

Expressions are obtained for the ray path in a parabolic type layer (magnetic field and absorption effects omitted). It is shown that the criteria for reflection at vertical incidence (a) n (refractive index) = 0, or (b) magnetic vector (H) in wave = 0 are both consistent with the analysis given in the paper.

W. J. G. BEYNON

538.566 : 551.510.535 : 621.396.11

7386. On the radio signal sent out vertically to the ground. L. KOŁODZIEJCZYK. *Soc. Sci. Lodz., Sect. III (No. 10) 14 pp.* (1948).

The case of vertical incidence reflection of radio waves by the ionosphere is considered as a stationary wave problem. A mathematical analysis of some of the properties of such a wave for a parabolic layer is given.

W. J. G. BEYNON

538.566 : 551.510.535 : 621.396.11

7387. Stationary waves in the ionosphere. L. KOŁODZIEJCZYK. *Soc. Sci. Lodz., Sect. III (No. 15) 15 pp.* (1949).

The analysis given in an earlier paper for a parabola type layer is generalized to cover the case of vertical incidence reflection of radio waves from an ionosphere having any type of ionization gradient [see also preceding Abstr.].

W. J. G. BEYNON

538.566 : 551.510.535 : 621.396.11

7388. Radio transmission of purely thermal origin in ionized regions. J. F. DENISSE. *J. Phys. Radium*, 11, 164-71 (April, 1950) In French.

The emission of r.f. energy from ionized regions is discussed for the case in which the region is in equilibrium and the electrons have only random energies. The mechanism of radiation by hyperbolic collisions between electrons and protons is considered and the work is extended to cover the case of a magnetic field, so that gyromagnetic terms have to be included. It is shown that Lorentz' calculation of the absorbing

power of an ionized gas gives a result identical with that obtained from the hyperbolic collision calculation. The energy radiated per cm³/sec per unit solid angle is

$$\int r \cdot dr = N_i \cdot N_e \cdot \frac{8}{3} \frac{e^6}{c^3 m^2} \left(\frac{m}{2\pi k T} \right)^{\frac{1}{2}} g \cdot dr$$

where g is a correction factor which for galactic noise varies linearly from approx. 20 at $\lambda = 300$ m to 1 at $\lambda \approx 15\mu$. For the solar corona $g \approx 16$, $300 < \lambda < 3 \times 10^{-3}$ m. g then falls linearly to 6 approx. at $\lambda = 3\mu$.

A. H. W. BECK

538.566 : 621.396.67

7389. Electromagnetic field of the conical horn. M. G. SCHORR AND F. J. BECK, JR. *J. Appl. Phys.*, **21**, 795–801 (Aug., 1950).

Maxwell's equations are solved for a perfectly conducting conical wave guide and the propagation coefficients of this guide are discussed. The field at the mouth of a finite conical horn is estimated and the radiation therefrom is calculated in integral form. These integrals are solved in series form for horns of small flare angle and moderate length and the results compared with experiment.

A.

538.566.2 : 621.396.11

7390. The effective permeability of an array of thin conducting disks. G. ESTRIN. *J. Appl. Phys.*, **21**, 667–70 (July, 1950).

A 3-dimensional array of thin conducting disks has found special application as an artificial refracting medium at microwave frequencies. Treatment of these refractive properties at oblique incidence requires specification of the dielectric and permeability coefficients of the medium.

When an alternating magnetic field is parallel to the disk faces, the field is undisturbed and the relative permeability coefficient is unity. When the alternating magnetic field is normal to the disk faces, circulating currents are induced on them. The boundary value problem of determining the current distribution on a single perfectly conducting disk is carried out in detail for the case where the disk diameter is small compared to the wavelength. This current distribution is found to be representable by a magnetic dipole. If the disks in an array are far enough apart to neglect interaction, a simple summation of the dipole moments shows the array to have a diamagnetic susceptibility in the direction normal to the disk faces.

Combining this result with an expression for the dielectric coefficient, developed earlier by Kock, the constants of the anisotropic array are completely specified.

A.

538.566.3 : 551.510.535 : 621.396.11

7391. Magneto ionic triple splitting of ionospheric waves. O. E. H. RYDBECK. *Proc. Indian Acad. Sci.*, **A**, **31**, 63–82 (Feb., 1950).

The appearance of a 3rd magneto ionic component or z-trace, also known as magneto-ionic triple splitting, has been examined theoretically and as a result it has been possible to show that strong coupling often exists between the ordinary- and z-components at a critical level. It has further been possible to show that the z-wave only is excited when the collisional

frequency ν is less than the critical collisional frequency ν_c of Appleton and Builder. This is physically easy to understand because the polarization curves of the σ - and z -modes only cross each other when $\nu < \nu_c$. Therefore the propagation of the σ -z wave always is of the transversal type. In the outer regions of the ionized layers and outside these, the σ -z wave not only behaves like an ordinary wave but actually is one. Consequently there is no need to make polarization measurements in order to find out the nature of this component. A useful expression for the transmission coefficient of the σ -z wave has been derived. It is shown theoretically that the z-trace only can appear with appreciable strength at high latitudes. It is further shown that coupled wave equations, similar to those appearing in this theory, under certain circumstances, yield the characteristic roots of the propagation exponent for the new electron-wave tubes. This indicates an interesting similarity between the excitation both of the z-waves in the ionosphere and the electron waves in the tube mentioned.

A.

538.566.3 : 551.510.535 : 621.396.11

7392. Radio wave propagation in a curved ionosphere. J. M. KELSO. *Proc. Inst. Radio Engrs*, **38**, 533–93 (May, 1950).

Using a double-parabola approximation to the Chapman distribution of electron density as a function of height, and assuming a curved-ionosphere, curved-earth geometry, analytic expressions are obtained for the true height of reflection, ray path, reflection coefficient, ground range, and group path. Graphical results are given for the maximum usable frequency factor. Where possible, the results are compared with those obtained by assuming a plane ionosphere. All calculations are made under the usual restrictions of neglecting the earth's magnetic field and most of the effects of collisions of electrons with heavy particles.

A.

538.566.3 : 621.396.11

7393. The trajectories of radio waves in the ionosphere. III. H. POEVERLEIN. *Z. angew. Phys.*, **2**, 152–160 (April, 1950) In German.

Continuation of 2 earlier papers [Poeverlein, S. B. Bayer, *Akad. Wiss.*, **175** (1948); Abstr. 2601 (1950)] in which the trajectories of radio waves in the ionosphere are calculated for cases in which the influence of the terrestrial magnetic field is included. The results of the calculations are exhibited graphically for both normal and oblique incidence propagation. The variation in the state of polarization of the wave and the validity of the ray theory in the neighbourhood of the reflection point are briefly considered.

W. J. G. BEYNON

538.569.3

7394. Absorption of u.h.f. radio waves in some substituted benzene compounds. S. N. SEN. *Indian J. Phys.*, **24**, 163–70 (April, 1950).

In continuation of previous work [see Abstr. 2603 (1950)], the absorption of u.h.f. radio waves of frequencies ranging from 250–530 Mc/s in chlorobenzene, toluene, ethyl benzene and nitro-benzene at temperatures ranging from 27°C to –94°C in the

at 3 cases and from 27°C to 5°C in the latter has been investigated. It is observed that there is a broad peak in the absorption curve of chlorobenzene at 410 Mc/s when the liquid is cooled to -30°C. The absorption becomes negligible when the liquid is solidified and kept at a temperature of -45°C. In the case of nitrobenzene at 26.7°C a similar peak is observed at a frequency of 505 Mc/s and in this case also, the absorption vanishes when the substance is solidified and kept at the melting point of the solid, i.e. at 5°C. In the case of toluene and ethyl benzene there is no absorption in the frequencies mentioned above in the temperature range from -95°C to 0°C. Also, when solidified, these two substances did not show any absorption of the radio waves. It is pointed out that the order of frequencies of rotational oscillations in the liquid state as indicated by these absorption peaks is different from that of the frequencies of the new Raman lines of these substances observed in the solid state. Thus the explanation offered by previous workers that such rotational oscillations of molecules are the cause of the new lines observed in the Raman spectra of the compounds in the solid state is not correct. A.

MAGNETIC EFFECTS 538.6

538.61

7395. A method of making magnetic lines of force visible. F. BLAHA. *Z. Naturforsch.*, **5a**, 233-4 (April, 1950) In German.

The pole pieces of a magnet were covered with a suitable insulating material containing a few holes or slits. They were connected to each other by a tube containing an anode and cathode necessary for electrical gas discharge, which, under suitable pressures, becomes visible along the lines of force originating from the uncovered points on the surfaces of the pole pieces. Typical photographs obtained are shown.

E. P. WOHLFARTH

538.614

7396. Magnetic rotatory polarization. On the invariance of the rotativity in the passage from the gaseous to the liquid state. Experimental study on iron oxide. R. DE MALLEMANN, F. SUHNER AND J. GRANGE. *C.R. Acad. Sci., Paris*, **230**, 1819-21 (May 22, 1950) In French.

Observations of improved precision have confirmed that the gaseous rotativity is 3% > the liquid. A.

538.614

7397. Phenomenological theory of magneto-optical processes. A. V. SOKOLOV. *J. Exp. Theor. Phys. USSR*, **20**, 451-2 (May, 1950) In Russian.

See Abstr. 1103 (1950). The present paper shows that it is not necessary to resort to a microscopical model, and that the properties of the dielectric tensor of the ferromagnetic permit of an adequate macroscopic representation. B. F. KRAUS

538.63 : 621.314.63

7398. The problem of magnetic resistance changes

in solid rectifiers. E. JUSTI AND G. VIEWEG. *Z. Naturforsch.*, **5a**, 231-3 (April, 1950) In German.

Careful experiments on Cu₂O and Se rectifiers, the former both with and without a graphite-containing contact layer ("Aquadag") indicate that without this layer magnetic resistance changes are absent, but that they are observable with the coated Cu₂O sample. For this sample the empirical relation $\Delta R/R = 2 \times 10^{-5} H^{2/3}$ was established, H being the field and i the current; maximum $H = 4.3 \times 10^4$ oersted and $i = 8$ mA gave $\Delta R/R = 5.6 \times 10^{-4}$. The effect is attributed to the graphite, where resistance changes had already been observed by Kapitza; the current is able to traverse the contact layer not only perpendicular to its surface but also parallel to it, owing to inhomogeneities. The absence of resistance changes in pure rectifiers is discussed. E. P. WOHLFARTH

538.652

7399. On the magnetostriction of alloys Ni-Mn in longitudinal and transverse fields. D. I. VOLKOV AND V. V. ZUBOV. *Dokl. Akad. Nauk, SSSR*, **71** (No. 5) 863-5 (1950) In Russian.

Examination of Akulov's second rule of even effects [*Z. Phys.*, **87**, 768-77 (Feb. 19, 1934)] and its extension to the phenomenon of magnetostriction in Ni-Mn alloys. This was measured by the Akulov method of wire tensometers in a broad interval of concentration (up to 21.5% Mn) against the intensity of external field. The behaviour of the longitudinal and transverse magnetostriction for an alloy close by composition to Ni₃Mn is also indicated.

Z. F. WOJNAR

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.11

7400. The cohesive energy of metallic magnesium. S. RAIMES. *Phil. Mag.*, **41**, 568-82 (June, 1950).

The method of Wigner and Seitz is applied to metallic Mg, using an ion-core field of the Hartree type. Two alternative self-consistent fields in the metal are considered, and the wave functions and energies are found not to differ significantly in the 2 cases. The total energy of the metal is obtained as the sum of 4 terms: the eigenvalue of the Schrödinger equation for the lowest state, and the Fermi, exchange and correlation energies. The free-electron approximation is used to evaluate the latter 2 terms, but, in the case of the Fermi energy, both the free-electron value and a modification of this using the effective electronic mass at the zone centre are considered: the effective mass being calculated by a method due to Bardeen. The energy of the valence electrons in a free atom is obtained by a self-consistent field calculation, and, in addition, an estimate is made of the correlation energy of these electrons. It is pointed out that the method employed in the latter case appears to be inapplicable to Be, so that the true

correlation energy may differ significantly from the estimated value. However, the calculated values of the lattice constant, cohesive energy and compressibility are found to be in fair agreement with experiment, and a discussion of the effects of the various approximations is given. A.

539.11 : 538.114 : 530.162

7401. On the statistics of solid solutions and ferromagnetics. E. TREFFTZ. *Z. Phys.*, **127** (No. 4) 371-80 (1950) *In German*.

The simple cubic, face-centred cubic and body-centred cubic lattices are considered in conjunction with the Bethe theory of solid solutions. Values of the specific heat are calculated and compared with known empirical values in the case of Ni, Fe and brass.

T. C. TOYE

539.11 : 548.7

7402. Compressibilities, force constants, and interatomic distances of the elements in the solid state. J. WASER AND L. PAULING. *J. Chem. Phys.*, **18**, 747-53 (May, 1950).

Available data for the compressibilities of crystalline elements are used to calculate the force constants for the assumed Hooke's law interactions between adjacent atoms. On comparison of these constants and the equilibrium interatomic distances it is found that for many substances there holds the relation discovered by Badger for diatomic gas molecules: a linear relation between the reciprocal of the cube root of the force constant and the interatomic distance, for elements of a given row in the periodic table. Deviations from this relation are in the direction of increased compressibility. They are explained as resulting from changes in bond type (that is, in electronic structure) that permit the crystal to adjust itself to the increased pressure. A.

MOLECULAR STRUCTURE 539.13

539.13 : 537.533.73

7403. Optical evaluation of molecular structure factors. C. R. BERRY. *Amer. J. Phys.*, **18**, 269-73 (May, 1950).

Electron diffraction patterns of molecules, assumed independently scattering, and optical diffraction of photographic projections of models of molecules, are shown to be similar, and to have intensity distributions proportional to the square of the molecular structure factor [Abstr. 393 (1945)]. Thus an optical experiment, details of which are described, enables electron diffraction patterns to be interpreted without making tedious computations of molecular structure factors. Experiments were performed which give a possible interpretation of the electron diffraction pattern of a cyanine dye adsorbed on a AgBr crystal.

A. R. STOKES

539.132

7404. On the determination of reciprocal matrices for the potential energy of polyatomic molecules.

(Method of combined steepest descent). P. G. MASLOV. *Dokl. Akad. Nauk, SSSR*, **71** (No. 5) 867-70 (1950) *In Russian*.

See Abstr. 5987-8 (1950). Provided the number of observed vibration frequencies greatly exceeds the number of unknown action coeffs., a method is suggested which gives a quick solution without the restrictions of the earlier methods. The iteration cycle extends over the square of the vibration frequency λ and over a vector x with components Q_i/Q_j where Q_i are the generalized forces. J. JACOB

539.13

7405. A note on the integral equations between molecular distribution functions. S. ONO. Letter in *J. Chem. Phys.*, **18**, 755-6 (May, 1950).

539.13

7406. The cubic secular equation for molecular vibrations. P. TORKINGTON. Letter in *J. Chem. Phys.*, **18**, 773-4 (May, 1950).

539.13

7407. Mean restoring forces of hydride di-atom and their positive ions. C. H. D. CLARK. Letter in *Nature, Lond.*, **165**, 1011 (June 24, 1950).

539.13

7408. The study of restricted rotation by gas diffraction. J. KARLE AND H. HAUPTMAN. *J. Chem. Phys.*, **18**, 875-80 (June, 1950).

A probability function has been derived which characterizes the variation of an interatomic distance affected by the restricted internal rotation of a molecule. The probability function takes into account the general vibration of the molecular frame in addition to the internal vibration. The theory and practice are developed for determining the values of the parameters in the probability function directly from experiment. In addition the contribution from this probability distribution to the intensity of electron scattering is derived. A.

539.132

7409. A molecular beam resonance method with separated oscillating fields. N. F. RAMSEY. *Phys. Rev.*, **78**, 695-9 (June 15, 1950).

An expression is obtained for the quantum mechanical transition probability of a system between two states when the system is subjected to such separated oscillating fields. This is numerically averaged over the molecular velocity distribution and provides the theoretical shape of the resonance curves. It is found that resonances with such a technique have a theoretical half-width only 0.6 as great as those by conventional molecular beam resonance methods. In addition to producing sharper resonance minima, the new method has its resonances much less broadened by inhomogeneities of the fixed field. It makes possible resonance experiments in regions into which an oscillating field cannot be introduced and it is more convenient and effective with short wavelength radiation. A.

539.132

7410. Anomalous thermal expansion of the short intermolecular bond in *para*-nitro-aniline. P. J. MCKEOWN, A. R. UBBELOHDE AND I. WOODWARD. Letter in *Nature, Lond.*, **166**, 69-70 (July 8, 1950).

539.132 : 531.19 : 536.7

1. The determination of energy levels from thermodynamic data. I. The effect of experimental procedures have been developed. E. BLADE AND G. E. KIMBALL. *J. Chem. Phys.*, **18**, 626-9 (May, 1950).

The problem of calculating energy levels from thermodynamic data can be reduced to that of inverting the Laplace transform, for which several procedures have been developed. Using the method of Widder, it is shown that the resultant calculated energy level density function consists of a series of broadened peaks, whereas in the true density the levels are represented by a series of Dirac delta-functions. Alternatively, if the distribution of the energy levels is specifically assumed to be composed of discrete energies, the calculation reduces to the moment problem. In either case the calculation is shown to have an inherent "resolving power," in that levels within a certain closeness cannot be distinguished as separate. By a generalization of this idea, it is shown that the computation can lead to a knowledge of the over-all density of energy levels within a given region, but cannot reveal their exact locations. A.

539.132 : 531.19 : 536.7

12. The determination of energy levels from thermodynamic data. II. The heights of potential energy barriers restricting intramolecular rotation. E. BLADE AND G. E. KIMBALL. *J. Chem. Phys.*, **18**, 26-36 (May, 1950).

The uncertainty in the distribution of the energy levels implies a corresponding uncertainty in the shape of the associated potential energy function. The estimation of barrier heights is known to depend upon the shape of the potential, therefore implicitly upon the energy level distribution. These ideas are applied to the restricted rotation problem by introducing a shape parameter into the assumed potential function, and show that the currently accepted barrier height ranges should be widened. On the basis of the modified function, the following barrier heights were found to be consistent with published thermodynamic data: ethane 1 550 to 2 700 calories per mole; 1,1,1-trifluoroethane 2 300 to 8 300; methanol 800 to 3 000. A.

539.132 : 533.7

13. The effects of saturation with microwaves on thermal properties. V. GRIFFING. *J. Chem. Phys.*, **18**, 744-5 (May, 1950).

It is assumed that saturation with microwave is observed because the two states, J and $J + 1$, are statistically filled. Under these conditions the change in the rotational partition function is temperature-dependent so that thermal properties of the system could be changed. The changes in the rotational specific heat are calculated for a linear molecule. This effect would produce a change in the specific heat of HCN of about 2 parts in 10 000, if the $v = 0 \rightarrow 1$ transition is saturated. A.

539.132 : 541.57

14. The molecular orbital theory of chemical valency. III. Properties of molecular orbitals. G. G.

HALL AND J. LENNARD-JONES. *Proc. Roy. Soc. A*, **202**, 155-65 (July 7, 1950).

The discussion of molecular orbitals and equivalent orbitals, given in previous papers [Abstr. 4915, 4916 (1949)], is carried a stage further. It is shown that certain molecular properties can be evaluated using either equivalent or molecular orbitals. On the other hand, a study of the changes produced by ionization demonstrates that molecular orbitals have a special significance and that certain energy parameters associated with them are closely related to ionization potentials. For the purpose of this discussion a perturbation theory is developed to deal with the changes produced in molecular systems when disturbed from their normal states. A.

539.132 : 541.57

7415. The molecular orbital theory of chemical valency. IV. The significance of equivalent orbitals. J. LENNARD-JONES AND J. A. POPLÉ. *Proc. Roy. Soc., A*, **202**, 166-80 (July 7, 1950).

See preceding Abstr. The theory of the transformation from molecular orbitals to sets of equivalent orbitals is discussed for the general case when there is more than one occupied molecular orbital of given symmetry and more than one equivalent set. The general transformation is worked out for molecules whose component atoms possess inner shells and lone pairs of electrons. The theory is illustrated by reference to some simple molecules such as water and ammonia. Finally, it is shown how the expression for the total energy of a molecule can be divided up in such a way that the interactions between its localized parts are dealt with separately. The significance of lone pairs of electrons in determining the shape of molecules is pointed out. A.

539.132 : 541.57

7416. The molecular orbital theory of chemical valency. V. The structure of water and similar molecules. J. A. POPLÉ. *Proc. Roy. Soc., A*, **202**, 323-36 (Aug. 7, 1950).

The theory of molecular and equivalent orbitals developed in previous papers of this series [see preceding Abstr.] is used to discuss the spatial distribution of lone-pair electrons in molecules such as H_2O and NH_3 and the part they play in determining the equilibrium configuration. Previous treatments of H_2O have assumed that the lone pairs are essentially unaltered by molecular formation. It is shown here, on the other hand, that they will be displaced so as to be mainly concentrated on the side of the O-nucleus remote from the H atoms. An important consequence of this is that the lone-pair electrons will make a contribution to the total dipole moment. Comparison of the experimentally observed moment with an approximate quantitative treatment suggests that, as a result of this, transfer of electrons from the H atoms to the O does not occur to the extent that has previously been believed. The variation of the spatial distribution of the orbitals of H_2O with changes of nuclear configuration is examined and it is shown that, in the equilibrium position, the electronic structure can be described approximately by 2 sets of 2 equivalent orbitals pointing in nearly tetrahedral directions. The dependence of total

energy on bond angle is discussed and it is shown that electrostatic repulsions between the equivalent orbitals are major factors in determining the equilibrium configuration. Similar considerations apply to NH_3 . A.

539.132 : 541.57

7417. The molecular orbital theory of chemical valency. VI. Properties of equivalent orbitals. G. G. HALL. *Proc. Roy. Soc., A*, **202**, 336-44 (Aug. 7, 1950).

The properties of equivalent orbitals, as defined in previous parts [see preceding Abstr.], are examined in more detail. It is shown that the character of an equivalent set can be deduced knowing the symmetry group of a single orbital of the set. This theorem has several useful applications. Further properties of equivalent sets are found by considering the structure of the molecular symmetry group in relation to the symmetry group of an orbital. An investigation whether or not equivalent orbitals in a molecule are uniquely defined shows that there are still degrees of freedom available which can be used to satisfy additional conditions. A.

539.132 : 541.65 : 535.66

7418. Excited electronic levels in conjugated molecules. IV. Symmetrical cyanine dyes. W. E. MOFFITT. *Proc. Phys. Soc., Lond., A*, **63**, 700-7 (July, 1950).

Topics in the electronic theory of the colour of symmetrical cyanine dyes have been discussed by means of resonance formalism. The author's conclusions for the formamidine ion have been confirmed by use of the molecular orbital method. As a result of this analysis, certain modifications in the qualitative symbolism of colour theory have been put forward in the hope that the factors governing absorption may be more clearly understood. A.

539.133

7419. Dipole moment of carbonyl cyanide. M. PUCHALIK. *Acta Phys. Polon.*, **10** (No. 1-2) 89-92 (1950).

This compound has an analogous structure to phosgene. It has been ascertained that in $\text{CO}(\text{CN})_2$ just as in COCl_2 , there appears a compensation of dipole moments of two strongly polar groups. A.

539.133

7420. Dipole moments and free rotation in molecules. M. PUCHALIK. *Acta Phys. Polon.*, **10** (No. 1-2) 93-101 (1950).

To test some consequences of the concept of free inner rotation in molecules: (a) the mean square dipole-moments of some members of the homologous series $\text{C}_5\text{H}_9(\text{CH}_2)_n\text{Cl}$, $\text{C}_6\text{H}_5(\text{CH}_2)_n\text{Cl}$ and $\text{C}_6\text{H}_{11}(\text{CH}_2)_n\text{Cl}$, and (b) the temperature-dependence of the mean square dipole-moment of benzyl chloride have been investigated. The results seem to confirm the theoretical predictions of Zahn and the results of some experiments of other authors. A.

539.133

7421. Magnetic shielding of nuclei in molecules. N. F. RAMSEY. *Phys. Rev.*, **78**, 699-703 (June 15, 1950).

An expression is developed for the magnetic field at a nucleus resulting from the application of an

external magnetic field to a polyatomic molecule which has no resultant electron orbital or spin angular momenta in the absence of the external field. The field at the nucleus is not the same as the externally applied field because of the field arising from the motion of the electrons in the molecule. The expression for the electron contribution to the magnetic field is shown to consist of 2 parts. The first is a simple term that is similar to the diamagnetic correction developed by Lamb for atoms. The second is a complicated one arising from second-order paramagnetism and is analogous to the term dependent on the high frequency matrix elements in the theory of molecular diamagnetism. Under certain circumstances the 2nd-order paramagnetic term can become quite large. Since both of these terms are altered when the same nucleus is in different molecules, they at least partially and perhaps completely explain the chemical effect that has been reported by various observers in measurements of nuclear moments. For linear molecules, the 2nd-order paramagnetic term is shown to be directly related to the experimentally measurable spin-rotational magnetic interaction constant of the molecule. This relation is particularly valuable in the important case of molecular H where it is shown that the correction for 2nd-order paramagnetism is -0.56×10^{-5} . When this is added to the Lamb-type term as calculated by Anderson, the total magnetic shielding constant for molecular H_2 becomes 2.68×10^{-5} . A.

539.133 : 535.343.4-14

7422. Microwave determination of the structure of borine carbonyl and of the nuclear moments of the stable boron isotopes. W. GORDY, H. RING AND A. B. BURG. *Phys. Rev.*, **78**, 512-17 (June 1, 1950).

From measurements on the $J = 1 \rightarrow 2$ and the $J = 2 \rightarrow 3$ rotational transitions of borine carbonyl its molecular structure and moments of inertia have been determined. Nuclear quadrupole couplings determined are 3.36 ± 0.10 Mc/s for B^{10} and 1.55 ± 0.08 Mc/s for B^{11} . Approximate values of the nuclear quadrupole moments are $0.06 \times 10^{-24} \text{ cm}^2$ for B^{10} and $0.03 \times 10^{-24} \text{ cm}^2$ for B^{11} . The nuclear spin of B^{10} is determined as 3 and that of B^{11} as 3/2. A.

ATOMIC STRUCTURE . ISOTOPES 539.15

539.15

7423. The mutual repulsive potential between argon atoms. M. KUNIMUNE. Letter in *J. Chem. Phys.*, **18**, 754-5 (May, 1950).

539.152

7424. On closed shells of neutrons and protons in the atomic nucleus. I. A. VAISMAN. *Dokl. Akad. Nauk, SSSR*, **71** (No. 5) 859-62 (1950) In Russian.

Neutrons and protons in nuclei form closed shells with 2, 8, 20 . . . particles; customarily it has been assumed that the number of particles in a shell and the sequence of shells are the same for neutrons and protons. Most stable nuclei have closed shells only.

and some elements with 1 extra particle do not occur in nature. This is explained by the sudden decrease in binding energy as 1 particle is added, sufficient to cause repulsion of protons and so hindering the formation of a nucleus. It is proposed that neutron and proton shells do not fill simultaneously and that existing theories of shell structure are incorrect.

J. JACOBS

539.152 : 530.12

Masses and energies of atomic nuclei. See Abstr. 7425.

539.152 : 535.343.4-14 : 548.7

7425. Angular dependence of crystalline nuclear resonance absorption. E. F. CARR AND C. KIKUCHI. Letter in *Phys. Rev.*, **78**, 470 (May 15, 1950).

539.152.1

7426. On the question of correlation of the number of neutrons and protons in atomic nuclei. V. I. SPITSYN. *Dokl. Akad. Nauk, SSSR*, **72** (No. 1) 41-4 (1950) in Russian.

A curve of Nn/Np (Nn number of neutrons, Np of protons) against atomic number is called the "normal curve" for the most stable nuclei (O, Si, Ca . . .). Each element is characterized by a value of Nn/Np and by the type of nuclear mass of its most widely occurring isotope. Of a group of isotopes, that one occurs most frequently naturally for which Nn/Np corresponds most closely to the value on the normal curve. Deviations from the normal curve are also related to radioactivity. Theoretical values of Nn/Np suggest the following isotopes to be the most stable: for neptunium Np^{237} , for plutonium Pu^{244} . J. JACOBS

539.152.1

7427. Magic numbers and elements with no stable isotopes. L. KOWARSKI. Letter in *Phys. Rev.*, **78**, 77-9 (May 15, 1950).

The abnormal instability of odd isotopes of ^{43}Tc , ^{81}Pm , ^{147}Pr and ^{147}Ce is possibly connected with the nearby magic neutron numbers 20, 50, 82. Even isotopes of ^{148}Ce and ^{148}Pm are also unstable, but their instability is already explained by parity rules. $I(=N-Z)$ is plotted against A for a range of nuclei, together with the idealized value of I given by the formulae of Weizsäcker and others, and it is shown that near $\bar{N} = 20$ or 82 the weak binding of an "open shell" neutron would produce the contradictions to the Weizsäcker picture which, in fact, occur. For the $\bar{N} = 50$ shell, however, a similar explanation of the instability of Tc would require the 56th neutron to be weakly bound, and a modification of the usual parity rules, affecting the binding of open shell neutrons, is suggested. Further indications of the behaviour of open-shell neutrons are afforded by the asymmetric fission of U and the general trend of slow neutron capture cross-sections. T. G. PICKAVANCE

539.152.1

7428. Nuclear coupling and shell model. G. RACAHA. Letter in *Phys. Rev.*, **78**, 622-3 (June 1, 1950). Additional remarks to Feenberg's paper [Abstr. 7408 (1950)].

539.152.1

7429. Binding energy of the triton. T.-M. HU AND

K.-N. HSU. Letter in *Phys. Rev.*, **78**, 633-4 (June 1, 1950).

Values calculated on the basis of various nucleonic interactions are tabulated.

539.152.1

7430. Mass-defect curves. A. M. MOSHARRAFA; M. EL NADI. Letters in *Nature, Lond.*, **164**, 662-3 (Oct. 15, 1949).

Observed and calculated values of $(W - A)$ are plotted against A for stable nuclei and the heavy natural radioelements, where W = atomic weight, A = mass number. The observed values are taken from L. Rosenfeld, "Nuclear forces"; the calc. values are given by el Nadi; the calc. curve is of the correct shape, but does not bring out the periodicity of 4 in the empirical curve for $A \leq 24$, and rises less steeply after the minimum.

A. O. STANESBY

539.152.1 : 539.155.2 : 535.338.333

7431. Spectroscopic isotope shift and nuclear polarization. G. BREIT, G. B. ARFKEN AND W. W. CLENDENIN. *Phys. Rev.*, **78**, 390-406 (May 15, 1950).

Staggering of term values of odd isotopes with respect to those of the even ones is discussed. The validity of the static picture of nuclei as applied to their interaction with electrons is examined. It is found that the partial excitation of nuclei by atomic electrons results in polarization effects which lower the energy by amounts comparable to the observed irregularities and staggering. Correlations of observed shifts with the formation of stable shells are also discussed in a tentative way. A.

539.152.1 : 539.155.2 : 535.338.333

7432. The Schmidt model and odd-even staggering of the isotopic shift. G. BREIT. Letter in *Phys. Rev.*, **78**, 470-1 (May 15, 1950).

539.152.1 : 539.164

7433. On the energy of the alpha-particles from radioactive nuclei. M. H. L. PRYCE. *Proc. Phys. Soc., Lond., A*, **63**, 692-700 (July, 1950).

When this energy is compared with the energy calculated from the usual semi-empirical formula for nuclear binding energies, systematic variations ranging from 4.5 MeV to -1.0 MeV are found, which exhibit in a very clear way the special importance of configurations containing 82 protons and/or 126 neutrons. The general features are readily explained in terms of the shell model. The analysis can be used to predict unknown α -energies. Calculated α -energies are tabulated for the heavy nuclei ($Z \geq 78$) and for nuclei in the rare-earth region. A.

539.152.1 : 539.172.3

7434. Theory of H^3 and He^3 photodisintegration and formation. M. VERDE. *Helv. Phys. Acta*, **23** (No. 4) 453-74 (1950) In German.

The photodisintegration and the formation by radiative capture of the two nuclei H^3 and He^3 are well suited to give information on the configuration of these nuclei and on the nature of nuclear forces. In this theoretical treatment the symmetry properties in ordinary space and in the spin and isotopic spin spaces are taken into account. The spatial configuration of the ground states of H^3 and He^3 , which appears to be predominantly totally symmetric in the

space co-ordinates, and the magnetic transition into a final state which consists of a ^3S deuteron and a free nucleon are discussed. This transition is forbidden for configurations totally symmetrical in space. This accounts for the observed low capture cross-section for thermal neutrons on deuterons. The electric transition into a final state consisting of a ^3S deuteron and a nucleon is calculated and the case of the direct transition into 3 free nucleons is considered. The formulae for the cross-section of the capture of a nucleon by a ^3S deuteron are given. A.

539.152.2

7435. Nuclear magnetic relaxation in metallic lithium and aluminium. N. J. POULIS. *Physica*, **16**, 373-6 (April, 1950).

Nuclear magnetic resonance absorption has been observed in metallic Al^{27} at a frequency of 9.5 Mc/s and in Li^7 at 15.2, 9.5 and 6.4 Mc/s. The relaxation time, τ_1 , was measured at temperatures from 20 to 1.2°K. For Li , τ_1 increases with increasing frequency. The line width in Li is about 3.5 oersteds, in Al about 9 oersteds. A.

539.152.2

7436. Nuclear magnetic resonance in weak fields. R. M. BROWN. *Phys. Rev.*, **78**, 530-2 (June 1, 1950).

The nuclear magnetic resonance for protons in water was observed in magnetic fields of 6 and 12 gauss corresponding to Larmor frequencies of 25 and 50 kc/s, respectively. The line width was found to be determined by the frequency of modulation and here was approximately 3 milligausses. The ratio of magnetic fields for resonance was found to agree with the ratio of Larmor frequencies within the experimental error, estimated at 0.01%. A.

539.152.2

7437. Saturation of output signal in [experiments on] nuclear paramagnetic resonance. M. SOUTIF AND R. GABILLARD. *C.R. Acad. Sci., Paris*, **230**, 2012-14 (June 5, 1950) In French.

The bridge method [Abstr. 7206 (1949)] and the autodyne method [Abstr. 7197 (1949)] used by the authors are considered as regards the possibility of attaining saturation. Experimental results obtained with the latter method are given in support of the theoretical results, and the influence of the paramagnetic ion concentration is investigated.

E. P. WOHLFARTH

539.152.2

7438. Nuclear magnetic moments and shell structure. R. K. WANGSNES. Letter in *Phys. Rev.*, **78**, 620-1 (June 1, 1950).

539.152.2

7439. The low states of Li^7 . R. AVERY AND C. H. BLANCHARD. *Phys. Rev.*, **78**, 704-10 (June 15, 1950).

An attempt is made to obtain consistency between the positive quadrupole moment of Li^7 as well as other known ground-state data, and the assumption that the wave function belongs to an s^2p^3 configuration of nucleons. This is found to be possible with only one particular form for the spin and angular dependence of the function, which is very different from that predicted by previous theory; in particular the D

and P state probabilities are found to be 80% and 20%, respectively. The validity of the analysis depends on the accuracy of the assumptions that the quadrupole moment is positive and due only to the charge distribution of the nucleons, with no contribution arising from their interaction. An investigation is also made of the spin of the Li^7 480 keV excited state. Previous arguments for a high spin are reviewed. Using the ground state wave function indicated, and assuming the s^2p^3 configuration also for the excited state, one can by further analysis show that an excited state of spin 5/2 or 3/2 would give fair agreement with experimental data (Be^7 K-capture data; $Li^{7*} \rightarrow Li^7 + \gamma$ lifetime). An excited state of spin 1/2, however, would give poor agreement. On the assumptions made, no agreement is possible for spin $> 5/2$. A.

539.152.2

7440. The electric quadrupole moment of the deuteron. G. F. NEWELL. *Phys. Rev.*, **78**, 711-14 (June 15, 1950).

A new electronic wave for the H molecule is calculated by use of the variation principle. From this the electric field gradient at one of the nuclei is determined and is used in conjunction with the quadrupole interaction energy as given by Kellogg, Rabi, Ramsey and Zacharias, to find the value of the quadrupole moment of the deuteron. The value obtained is $Q_D = (2.766 \pm 0.025) \times 10^{-27} \text{ cm}^2$. The probable error of 0.9% is an improvement over the previous error of 2% given for Nordsieck's calculation of $Q_D = 2.73 \times 10^{-27} \text{ cm}^2$ and for Ishiguro's value of $Q_D = 2.79 \times 10^{-27} \text{ cm}^2$. A.

539.152.2

7441. Measurement of the proton moment in absolute units. H. A. THOMAS, R. L. DRISCOLL AND J. A. HIPPLE. *Phys. Rev.*, **78**, 787-90 (June 15, 1950). Also in *J. Res. Nat. Bur. Stand., Wash.*, **44**, 569-83 (June, 1950).

By measuring the absolute value of the magnetic field and the frequency required for nuclear resonance absorption in a water sample, the gyromagnetic ratio of the proton has been determined to be $\gamma_p = (2.67528 \pm 0.00006) \times 10^4 \text{ sec}^{-1} \text{ gauss}^{-1}$. With this value and Planck's constant the value of the magnetic moment of the proton in absolute units becomes $\mu_p = (1.4100 \pm 0.0002) \times 10^{-23} \text{ dyne cm/gauss}$. A combination of this result with recent measurements of the proton moment in Bohr magnetons by Gardner and Purcell results in a value of $e/m = (1.75890 \pm 0.00005) \times 10^7 \text{ e.m.u. gram}^{-1}$. A.

539.152.2 : 535.338.332

7442. A note on the electric quadrupole moments of the two copper isotopes Cu^{63} and Cu^{65} . P. BRIX. *Z. Phys.*, **126** (No. 10-12) 725-7 (1949) In German.

Some measurements on the hyperfine structure of the $Cu I$ lines [H. Schüler and T. Schmidt, *Z. Phys.*, **100** (No. 1-2) 113-16 (1936)] have been re-examined with the aid of an accurate determination [Abstr. 2173 (1948)] of the ratio of magnetic moments for Cu^{63} and Cu^{65} . The nuclear quadrupole moments in units of 10^{-24} cm^2 are found to be -0.26 ± 0.10 for Cu^{63} , -0.15 ± 0.10 for Cu^{65} . A. P. FRENCH

539.152.2 : 539.155.2

43. Nuclear magnetic moments of the gallium isotopes. P. KUSCH. Letter in *Phys. Rev.*, **78**, 615-16 (June 1, 1950).

Experimental values have been recalculated, and the discrepancy ($\sim 0.7\%$) between the moments obtained from magnetic resonance experiments and those from the Zeeman effect of the hyperfine structure [Abstr. 6015 (1950)] appears to be real.

539.152.2 : 548.7

44. Proton nuclear magnetic resonance studies in H_2PO_4 , KH_2AsO_4 , $\text{NH}_4\text{H}_2\text{PO}_4$, and $\text{NH}_4\text{H}_2\text{AsO}_4$. J. NEWMAN. *J. Chem. Phys.*, **18**, 669-78 (May, 1950).

Studies have been made at 30 Mc/s. Both line shapes and relaxation times have been measured from 77°K to 293°K. The K salts show closely similar magnetic resonance properties. Their relaxation times show relatively small variation in the temperature interval studied. The characteristic times derived therefrom do not obey any simple exponential law of the reciprocal temperature. Single crystals of H_2PO_4 do not seem to show anisotropy in the relaxation time. A formula is given which relates the anisotropy of the motion of magnetic dipoles to the anisotropy of transverse local field variation. The ammonium salts show 2 minima in their relaxation time v. temperature curves. One minimum corresponds to a temperature at which the acid hydrogens are the most effective relaxation agent and the other to a temperature where the ammonium ion hydrogens are most effective. The line shapes are also of a composite character. This is most clearly shown below 100°K where the absorption lines appear to be superpositions of the broad NH_4 line for which that of NH_4Cl is typical and the narrow line found in KH_2PO_4 or KH_2AsO_4 . Possible interpretations of the experimental results are discussed with reference to the motions of the protons in these crystals. A.

539.153

445. The fine structure of singly ionized helium. W. E. LAMB, JR. AND M. SKINNER. *Phys. Rev.*, **78**, 539-50 (June 1, 1950).

The displacement $2^2S_{1/2} - 2^2P_{1/2}$ in singly ionized He has been determined to be $14\,020 \pm 100$ Mc/s. The method is analogous to that employed for H by Lamb and Retherford, except that no beam of metastable ions is formed. Instead, He atoms are bombarded by electrons of a few hundred volts energy. In about 1% of the ionizing collisions, the remaining atomic electron is excited to the metastable $2^2S_{1/2}$ state of the ion. When the bombardment region is illuminated with microwave radiation of the proper frequency, transitions to the $2^2P_{1/2}$ state are induced, and the ultraviolet photons emitted in the subsequent decay to the ground state $1^2S_{1/2}$ are detected by a suitable photoelectric detector. Background effects due to metastable atoms and radiation from He I are reduced by the use of a collodium film filter. The experimental value for the $2^2S_{1/2} - 2^2P_{1/2}$ level shift is about 1.4% higher than the present theoretical value. A.

539.153 : 523.87

446. The oscillator strength for the $4s - 4p$

transition in Ca II. L. C. GREEN AND N. E. WEBER. *Astrophys. J.*, **111**, 582-6 (May, 1950).

Three fields were used to obtain the necessary wave functions: a self-consistent field both with and without exchange and a field of the Kramers type. With each field the radial integrals for the dipole moment, for two forms of the dipole momentum, and for the dipole acceleration were evaluated. Each of these radial integrals was then used to calculate two values of the oscillator strength. One value was obtained by using the observed energy difference, and a second by using the difference of the eigenvalues of the particular wave functions employed in computing the radial integrals. Values from the same field and values from different fields were found to be in closer agreement when the calculated, rather than the observed, energies were employed. Comparison of the various results suggests that the true value of the oscillator strength for this transition probably lies within ± 0.10 of the value 1.07 . A.

539.153 : 523.87

447. Oscillator strengths for the $4s - p$ and the $3d - f$ continua of Ca II. L. C. GREEN AND N. E. WEBER. *Astrophys. J.*, **111**, 587-92 (May, 1950).

Values of df/de have been redetermined [see Abstr. 5907 (1949)] using wave functions derived by numerical integration from a self-consistent field without exchange. For both continua the values found from the dipole moment, momentum and acceleration expressions for df/de agree closely when calculated values of ϵ are used. The meaning of this agreement is examined. Evidence suggests that the oscillator strengths for the $4s - p$ continuum are somewhat more accurately known than has recently been supposed. The $3d - f$ continuum retains the large size found in previous work and is therefore distinctly not like hydrogen. A.

539.153 : 538.222

448. Magnetic resonance absorption in nitric oxide. R. BERINGER AND J. G. CASTLE, JR. *Phys. Rev.*, **78**, 581-6 (June 1, 1950).

The 9-line magnetic resonance spectrum of $\text{N}^{14}\text{O}^{16}$ is observed at fields in the range of 8 600 oersted at a frequency of 9 360 Mc/s. The spectrum arises from magnetic-dipole transitions between Zeeman levels in the $J = \frac{3}{2}$ state of the $^2\Pi_{3/2}$ spin component. The line positions allow a determination of the magnetic IJ coupling constant (29.8 ± 0.3 Mc/s), and the nuclear electric quadrupole coupling (-1.7 ± 0.5 Mc/s). The line position and triplet spacings, which arise from molecular perturbations, are in good agreement with the theory of Margenau and Henry. The absolute intensity of the three stronger lines is measured to be $\chi'' = 1.2 \times 10^{-10}$, which also agrees with theory. A.

539.153 : 538.222

449. Theory of magnetic resonance in nitric oxide. H. MARGENAU AND A. HENRY. *Phys. Rev.*, **78**, 587-92 (June 1, 1950).

The molecular Zeeman effect is calculated in detail and found to yield good agreement with experiment. Consideration is given to the energy of interaction, (a) of the spin of the N^{14} nucleus with the total

electronic angular momentum in the external field, and (b) of the quadrupole moment of N^{14} with the electric field at the N^{14} nucleus. The last section contains an evaluation of the matrix elements needed in the computation of absolute intensities for the transitions within the $2\Pi_{3/2}$ level. A.

539.155.2

7450. Regularities of isotopic abundances. A. E. KEMPTON. *Nature, Lond.*, **165**, 801-2 (May 20, 1950).

The isotopic abundances of elements of even atomic number, Z , vary regularly. To show the regularities the simplest way is to plot the ratio (abundance of odd isotope)/(abundance of preceding even isotope) against Z . Between $Z = 8$ and $Z = 40$ there are 3 sharp maxima. Above $Z = 40$ two curves are obtained, corresponding to the two odd isotopes. In gross features they are similar, but vary a good deal in detail. Above $Z = 60$ the curve becomes quite different, though it is probable that periodicity is still present up to $Z = 80$. The cause of the regularities is discussed in terms of the cosmological origin of the elements and the regular variation of neutron capture cross-section. A. J. MEE

539.155.2 : 53.081.7

7451. Researches on heavy water. T. L. CHANG. *Nat. Peking Univ. Semi-Cent. Vol., Math. Phys. Biol. Ser.*, 129-42 (1948).

Some of the results of a series of experiments started in 1935. Methods are stated and tables and curves given. Sections are devoted to: density (3.8° – 101.4°); vapour pressure (3.8° – 371.5°) and heat of vaporization (3.8° – 230°); critical constants; freezing point lowering; solubility of salts; distribution coefficient (I_2 , D_2O , CCl_4); electrolytic concentration; chemical kinetics in D_2O ; synthesis from D_2O ; attempt to enrich HDO and H_2O^{18} through fractional crystallization (negative result); physical constants of HDO and H_2O^{18} ; distribution of HDO and H_2O^{18} in nature (variations attributed mainly to evaporation process); effect of fluctuating concentrations of HDO and H_2O^{18} in water on the fundamental units of physical standards.

539.155.2 : 533.15

7452. On the thermodynamic efficiency of methods of isotope separation. G. DICKEL. *Naturwissenschaften*, **37** (No. 7) 164-5 (1950) *In German*.

A formula for the thermodynamic efficiency of short Clusius-Dickel thermal diffusion tubes is given similar to one by Jones and Furry [Abstr. 1273 (1947)]. This is compared with the actual performance of separation plants built by Clusius and the author and it is concluded that there is room for considerable improvement by operating the columns under optimum conditions. H. LONDON

539.155.2 : 533.15

7453. Dependence of the inversion temperature of thermal diffusion of isotopes on the mean molecular mass. E. W. BECKER AND E. DÖRNENBURG. *Naturwissenschaften*, **37** (No. 7) 165-6 (1950) *In German*.

The inversion temperature of thermal diffusion T_i , below which the heavier molecules are enriched at the hot wall, was determined in a Clusius-Dickel tube.

For $C^{13}O^{16}_2/C^{12}O^{16}_2$ $T_i = 300^\circ K \pm 10^\circ$ and for $C^{12}O^{18}O^{16}_2/C^{12}O^{16}_2$ $T_i = 365^\circ K \pm 10^\circ$. Values of the abundance ratios are given for two temperature combinations. H. LONDON

539.155.2 : 535.343.4-11

Microwave measurements on the Se isotopes in OCSe. See Abstr. 7134

RADIOACTIVITY. α -, β - AND γ -RAYS 539.14

539.16.08

7454. A study by the photographic method of the active deposits obtained from various radioactive substances. A. HEE, M. JAROVY AND J. KLEIBER. *C.R. Acad. Sci., Paris*, **230**, 1520-2 (April 24, 1950) *In French*.

Active deposits of 3 radioactive minerals, obtained on a disk charged — vely with respect to a thin layer of mineral placed close to it, were studied by placing the surface of the disk in contact with a photographic plate and measuring the α -particle tracks so produced. In addition to tracks corresponding to Th and Ra active deposits, shorter ranges were observed, and attributed to U, Ra, AcX and ThX; the mechanism is somewhat obscure. A. O. STANESBY

539.16.08 : 519.214

7455. Some probability distributions connected with recording apparatus. II. C. DOMB. *Proc. Camb. Phil. Soc.*, **46** (Pt 3) 429-35 (1950).

The method of a previous paper [Abstr. 2303 (1948)], using the Laplace transform, is applied to find the probability distributions in some problems recently discussed by Feather [Abstr. 339 (1950)]. A type of recorder which remains dead as long as events succeed each other at intervals less than a fixed amount [Abstr. 2541 (1948)] is also considered.

L. S. GODDARD

539.163

7456. Application of proportional scintillation γ -ray counters to the determination of radioactive decay schemes. P. E. CAVANAGH. Letter in *Nature, Lond.*, **165**, 889-90 (June 3, 1950).

539.163

7457. On neutron deficient isotopes of barium. C. C. THOMAS, JR. AND E. O. WIG. *J. Amer. Chem. Soc.*, **72**, 2818 (June, 1950).

539.163

7458. Radioactive isotopes of barium. R. W. FINK AND D. H. TEMPLETON. *J. Amer. Chem. Soc.*, **72**, 2818-19 (June, 1950).

539.163 : 530.145

The theory of spontaneous and "forced" K-capture. See Abstr. 7001

539.163.1

7459. The half-life of Cm^{242} . G. C. HANNA, B. G. HARVEY AND N. MOSS. Letter in *Phys. Rev.*, **78**, 617-18 (June 1, 1950).

The "best value" is $162.7 - 0.2$ days = 162.5 days. The limits of error are probably ± 2 days.

539.163.1
60. Specific activity of potassium. W. R. FAUST. Letter in *Phys. Rev.*, **78**, 624 (June 1, 1950). Results obtained for the specific disintegration rate are 31.2 ± 3.0 beta-rays/sec.-g K, and 3.6 ± 0.4 gamma-rays/sec.-g K.

539.163.1
61. A long-lived zirconium activity in fission. P. STEINBERG AND L. E. GLENDEIN. Letter in *Phys. Rev.*, **78**, 624-5 (June 1, 1950). A zirconium activity has been isolated from uranium fission of $\sim 5 \times 10^6$ yr half-life, emitting beta-rays of 60 ± 5 keV maximum energy, which is probably Zr_{93} .

539.163.2
62. New beta-emitting isotopes in region of tungsten. M. LINDNER AND J. S. COLEMAN. Letter in *Phys. Rev.*, **78**, 67 (April 1, 1950).

539.163.2
63. New isotopes of neptunium. L. B. MAGNUSON, S. G. THOMPSON AND G. T. SEABORG. *Phys. Rev.*, **78**, 363-72 (May 15, 1950).

Evidence is presented for three new, light Np isotopes formed by deuteron bombardments of U^{233} , U^{235} and U^{238} . The isotope Np^{231} has a half-life of 10 ± 3 min and emits α -particles of 6.28 MeV energy; the proportion of decay by electron-capture has not been determined. The isotope Np^{233} decays predominantly by electron-capture with a 35 ± 3 min half-life; it has an α -decay half-life roughly determined to be ca. 10 yr corresponding to a K/α -branching ratio of 1.5×10^5 , and the α -particles have an energy of 5.53 MeV. A 13 $\pm$ 3 min period with electromagnetic radiation, indicating orbital electron-capture, is attributed to Np^{232} . Approximate cross-sections for formation of various Np isotopes by neutrons of energy from 15 to 100 MeV have been determined. The cross-sections are low, of the order of 10^{-26} cm², possibly because most of the excited nuclei undergo fission. A.

539.163.4 : 541.6 : 532.73
7464. The general method of determining the composition and molecular structure of the chemical compounds of elements, present in radiochemical, i.e. imponderable, quantities. V. G. KHLOPIN. *Dokl. Akad. Nauk, SSSR*, **71** (No. 5) 901-3 (1950) In Russian.

The following rule is formulated: If the distribution of a micro-component (radio-element) between a solid crystalline phase and a solution follows exactly the law of distribution between 2 immiscible solvents, and if the crystallization coefficient remains constant when the concentration of the distributed substance varies within wide limits (several orders of magnitude)—such behaviour may serve as a test for the applicability of Mitscherlich's law to a given pair of substances (salts), i.e. of inferring the similarity of the chemical composition and molecular structure between the macro- and micro-component. F. LACHMAN

539.164 : 537.534.75
7465. The range-energy relation for slow alpha particles and protons in air. H. A. BETHE. *Rev. Mod. Phys.*, **22**, 212-19 (April, 1950). Existing data on range-energy relations in air for

protons and alphas at low energies have been re-examined in the light of evidence that the ionization in A is exactly proportional to the energy. New relations are presented for protons between 0 and 1.8 MeV and for alphas between 0 and 8 MeV.

G. O. BAINES

539.164.92 : 532.62 : 532.694
7466. Observations on the destruction of foams and thin films by the α -particles of polonium. A. DER. *J. Phys. Radium*, **11**, 198-200 (April, 1950) In French.

Experiments are described which show that the maximum destruction occurs at that point on the α -particle track corresponding to the maximum specific ionization. J. HUGHES

539.165
7467. A reinterpretation of the electron spectra of radioactive ytterbium and tantalum. J. M. CORK, H. B. KELLER, W. C. RUTLEDGE AND A. E. STODDARD. *Phys. Rev.*, **78**, 95-8 (April 15, 1950).

Highly purified Yb, on irradiation in the pile, yields radioactivities whose half-lives are found to be 32.4, 4.2 and 6.7 days, in addition to the 2.4 hr activity known to exist. The 32.4 day activity is assigned to Yb^{169} which decays by K-capture to excited Tm^{169} , yielding no general beta-radiation, but about 30 electron conversion lines which are interpreted as due to 10 gamma-rays. Many of the gamma-rays fit into a simple level scheme. The 4.2-day activity is assigned to Yb^{175} and in addition to a strong beta-radiation shows conversion electron lines indicative of 4 gamma-rays. It is shown that the 6.7 day activity is a daughter product in Lu^{177} , growing from a radioactive Yb^{177} which is presumably the well known 2.4 hr activity. A re-interpretation of the approximately 40 electron conversion lines in radioactive Ta^{182} leads to 18 gamma-rays, all of which fit well a proposed energy level scheme. A.

539.165
7468. Energy of beta particles and photons from Ca^{45} , Zn^{65} and Co^{60} by absorption. L. SIMONS. *Comment. Phys. Math. Helsingf.*, **15** (No. 9) 1-11 (1948).

The range and maximum energy of beta radiation from Ca^{45} , Zn^{65} and Co^{60} have been determined by absorption in Al. In addition the half-thickness and energy of gamma radiation from Zn^{65} have also been determined. The range of the beta particles was determined according to Feather's analytical method described by Glendenin. In addition a hypothesis by which the energy spectrum of beta radiation can be approximated from absorption measurements. A comparison between the results obtained from absorption and beta-spectrographic measurements shows that even for maximum ranges of approximately 0.2 MeV the spectra agree at the maximum end. As a trial an energy spectrum is construed on the basis of the beta absorption for Ca^{45} . The fact that the Fermi curve ends in a nearly straight line confirms in a way the correctness of the spectrum. In addition the Fermi diagram gives a maximum-energy in agreement with the one obtained according to the Feather analysis. A.

539.165

7469. Beta-spectra of gaseous A^{41} and O^{15} . H. BROWN AND V. PEREZ-MENDEZ. *Phys. Rev.*, **78**, 649-55 (June 15, 1950).

A magnetic β -semicircular focusing spectrometer with a radius of curvature of 13.6 cm has been constructed and adapted for the measurement of the β -ray spectra of emitters in gaseous phase. The radioactive gases were produced by deuteron bombardment of gaseous samples in a cyclotron using special probes. A^{41} (109 min) produced by the $A^{40}(d, p)$ reaction showed a spectrum of maximum energy (1.245 ± 0.005) MeV and an allowed spectrum shape down to at least 200 keV. The half-life of O^{15} , produced by the $N^{14}(d, n)$ reaction, was determined to be (118.0 ± 0.6) sec. The end point of its positrons was (1.638 ± 0.005) MeV. The Fermi plot departed from linearity at 300 keV, but this effect may be of experimental origin. A.

539.165 : 537.132

Annihilation of positrons in gases. See Abstr. 7221

539.165.08 : 537.533.74

7470. Back-scattering of electrons into Geiger-Müller counters. L. YAFFE AND K. M. JUSTUS. *J. Chem. Soc. S (Suppl. No. 2)* 341-51 (1949).

Increases in counting rates, the effect of varying the energy of the β -emitter, the atomic number, and the mass thickness of the back-scatterer have been determined. Empirical relationships are given from which correction factors may be determined. The characteristics of the scattered radiation are shown. Suggestions are made for standardizing counting techniques. A.

539.165.2

7471. The theory of β -decay using a linear combination of relativistic invariants for the interaction Hamiltonian. S. R. DE GROOT AND H. A. TOLHOEK. *C.R. Acad. Sci., Paris*, **230**, 1510-12 (April 24, 1950) *In French*.

The restrictions on the 5 constants in the most general interaction are discussed in terms of existing spectra and angular correlation measurements.

G. J. KYNCH

539.165.2

7472. Relation between apparent shapes of monoenergetic conversion lines and continuous beta-spectra in a magnetic spectrometer. II. G. E. OWEN AND H. PRIMAKOFF. *Rev. Sci. Instrum.*, **21**, 447-50 (May, 1950).

The method worked out previously [Abstr. 1146 (1949)] for correcting distortions which affect the apparent shape of a continuous beta-spectrum has been further extended. A general solution of the integral equation governing the relation between the true and the observed spectra is given, and is applied to the correction of the experimental spectra from a 1 mg/cm² source of Cu^{64} . The kernel of the distortion integral equation is determined from a study of the internal conversion lines of I^{131} (47 and 330 keV) using sources of various thicknesses from 0.042 to 0.840 mg/cm². It is found that the discrepancy between the experimental Cu^{64} negatron and positron spectra and those predicted by the Fermi ("allowed")

theory can be completely understood as a thick source effect.

539.166

7473. Gamma-rays from thulium-170. P. J. GRANT. Letter in *Nature, Lond.*, **165**, 1018 (June 24, 1950).

539.166

7474. A study of the polarization-direction correlation of successive gamma-ray quanta. F. METZGER AND M. DEUTSCH. *Phys. Rev.*, **78**, 551-8 (June 1, 1950).

A gamma-ray polarimeter utilizing Compton scattering as the analysing process is described. Measurements of the polarization-direction correlations of the gamma-rays emitted in the disintegration of Sc^{46} , Co^{60} , Rh^{106} and Cs^{134} are reported. A.

539.166

7475. Angular correlation of successive gamma-rays. E. L. BRADY AND M. DEUTSCH. *Phys. Rev.*, **78**, 558-66 (June 1, 1950).

The angular correlation of successive gamma-rays emitted by 6 even-even nuclei has been investigated and found to be anisotropic in every case, and of the magnitude expected theoretically. Effects of external magnetic fields and of chemical binding on the correlations are found to be smaller than the experimental uncertainty for some exploratory experiments. Interpretation of the results in terms of the nuclear states involved is in general possible by use of additional evidence such as relative transition probabilities. A.

539.166 : 537.5422

Scintillation counting of gamma-rays. See Abstr. 7322

539.166 : 539.1644

7476. A study of the γ - and X-radiation emitted by radioactinium, ionium and radiothorium. M. RIOU. *J. Phys. Radium*, **11**, 185-94 (April, 1950) *In French*.

Using the selective absorption method, it was found that $RdAc$, Io and $RdTh$ all emit the characteristic L -radiation of Ra , and with the same relative intensities of L_I , L_{II} , L_{III} . The absolute intensities of the γ - and L -radiation from Io and $RdTh$ are in accord with the α -particle fine structure, but not with the number of L conversion electrons. A. O. STANESBY

539.166.1

7477. The gamma-rays from $Be^9(\alpha, n)$. R. W. PRINGLE, K. I. ROULSTON AND S. STANDIL. Letter in *Phys. Rev.*, **78**, 627 (June 1, 1950).

539.166.2 : 537.542

7478. Proportional counters in a magnetic field; an investigation of the nuclear isomerism in Br^{80} . P. ROTHWELL AND D. WEST. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 539-41 (May, 1950).

A technique previously described [Abstr. 3887 (1948), 681 (1949)] has been extended. In order to measure secondary electrons up to 100 keV released in a proportional counter, it was placed in a field of 7 500 gauss, thus curling up the electron tracks, and so confining them to the counter gas. The field was shown to have no effect on the 2.8 keV line from A^{37} , which may be measured satisfactorily without the magnetic field. The internal conversion coefficient of the 37 keV γ -ray from Br^{80} was found to be 1.3,

disagreement with other work [Abstr. 1602 (1947)], indicating that the transition is electric dipole.

B. ROSE

539.166.2 : 537.542

79. The calibration of proportional counters with γ -rays produced by radioactive sources. P. ROTHWELL and D. WEST. Letter in *Proc. Phys. Soc., Lond. A*, **5**, 541-3 (May, 1950).

K -capturing nuclides, and thin foils bombarded by particles, have been used to produce monokinetic γ -rays for the calibration of proportional counters working in a magnetic field [see preceding Abstr.]. Suitable relatively long-lived nuclides are listed, which may be produced by thermal neutron irradiation in a pile, with energies from 5 to 50 keV.

B. ROSE

539.166.2 : 537.542

480. Measurement of gamma-ray energies with one crystal. J. A. MCINTYRE AND R. HOFSTADTER. Letter in *Phys. Rev.*, **78**, 617-19 (June 1, 1950).

Pulse distributions for scintillations from NaI-Tl crystals due to collimated and uncollimated Co^{60} gamma rays are measured. Curves show good energy resolution of components when photo-electric effect in I is used (small crystals). The Compton effect broadens the distributions for large crystals.

G. F. J. GARLICK

539.166.2 : 537.542

481. Measurement of gamma-ray energies with two crystals in coincidence. R. HOFSTADTER AND J. A. MCINTYRE. Letter in *Phys. Rev.*, **78**, 619-20 (June 1, 1950).

By using NaI crystals in coincidence, the second detecting scattered γ -rays from the first after a Compton encounter, very high energy resolution is obtained for Co^{60} , RaC and Sb^{124} γ -rays.

G. F. J. GARLICK

539.166.74

7482. On the scattering of γ -rays in water. Experimental study. P. MAIGNAN. *C.R. Acad. Sci., Paris*, **230**, 2088-90 (June 12, 1950) In French.

The scattering of the γ -rays from a RdTh source in a large tank of water was investigated, and satisfactory agreement with theory obtained.

A. O. STANESBY

539.166.9

7483. On the detection of γ -ray polarization by pair production. T. H. BERLIN AND L. MADANSKY. Letter in *Phys. Rev.*, **78**, 623 (June 1, 1950).

NUCLEAR REACTIONS 539.17

539.17: 621.389

7484. Electronics at the [French] Department of Atomic Energy. M. SURDIN. *Onde Élect.*, **30**, 154-6 (April, 1950) In French.

A short historical introduction to a series of more detailed papers.

A. O. STANESBY (R)

539.17 : 621.389

7485. Electronic instrumentation in atomic research. D. TAYLOR. *Engineering*, **169**, 631-4 (June 2); 644-5 (June 9, 1950).

A comprehensive review, under 5 headings

(atomic pile safety and control, radio-activity assay, automatic equipment, effluent measurement and radiation monitoring) of the different applications of radiation detectors. Normally, ionization chambers and Geiger-Müller counters of varying sizes and types are used, connected to individual circuits, recorders, control mechanisms, etc., to suit the need. The use of scintillation counters is growing for some applications. Brief details with schematic diagrams are given of typical instruments, together with an outline of the operation of an atomic pile.

E. D. HART (R)

539.172

7486. Notes on high energy nuclear evaporation. Y. YAMAGUCHI. Letter in *Progr. Theor. Phys.*, **5**, 142-3 (Jan.-Feb., 1950).

The problem of nuclear evaporation is generalized to the case when α -particles can be emitted in addition to neutrons and protons. The consequent change in the relative number of neutrons and protons emitted is small.

W. J. SWIATECKI

539.172

7487. The use of cloud chambers with pulsed accelerators. E. HAYWARD. *Science*, **111**, 349-55 (April 7, 1950).

The successful applications have used X-ray and neutron beams secondary to the accelerated particles, since ionization in the cloud chamber is produced only when particles or quanta interact. The controlled timing of the cycle of operation allows pulsed magnet operation and immediate condensation on sharp tracks. The reduced distortion arising under these conditions allows cleaning expansions to be replaced by over-compression to remove evaporation nuclei, and the subsequent expansion to be taken after unusually short recovery time.

J. G. WILSON

539.172

7488. The spallation products of antimony irradiated with high energy [100 MeV] particles. M. LINDNER AND I. PERLMAN. *Phys. Rev.*, **78**, 499-508 (June 1, 1950).

The distribution and yields have been determined for a considerable number of products. The highest yields were found for nuclei about 5 mass numbers removed from the target material, showing that compound nucleus formation is not an important mechanism in such high energy reactions. Products in lower yields were found which probably resulted from nuclei which had been excited to the full energy of the projectile. A more detailed discussion of the types of reactions responsible for the observed products is given.

A.

539.172

7489. Disintegration of nuclei by π^- -mesons. W. B. CHESTON AND L. J. B. GOLDFARB. *Phys. Rev.*, **78**, 683-5 (June 15, 1950).

Investigations of nuclear disintegrations induced by π^- -meson absorption in nuclear emulsions, exposed to the π^- -meson beam of the 130-in Rochester cyclotron, have been carried out. The energy spectrum of the protons emitted from the absorptions shows 2 distinct processes occurring: (a) evaporation of nucleons from an excited nucleus and (b) emission of knock-on protons, brought about by the interaction of a π^- -meson with a multi-particle structure

in the nucleus. Of the mesons ending in the emulsion, $10 \pm 2\%$ give rise to protons with energies ≥ 30 MeV. Strong evidence is presented for the boson character of the π^- -meson. A.

539.172

7490. Deuteron reactions with separated neon isotopes. J. AMBROSEN AND K. M. BISGAARD. Letter in *Nature, Lond.*, **165**, 888-9 (June 3, 1950).

Separated neon isotopes, prepared in a mass-spectrograph, were bombarded with 1.5 MeV deuterons from a Van der Graaff generator. Particles emitted at 90° were recorded in C2 photographic plates; elastically scattered deuterons were absorbed in a thin foil. Track length distributions showing proton groups from (d, p) reactions in Ne^{20} and Ne^{22} are presented, and the group energies tabulated. Two long-range groups (9.29 and 7.96 MeV) in the Ne^{21} bombardment are assigned to $\text{Ne}^{21}(d, p)\text{Ne}^{22}$ on the basis of tests of contamination from $\text{N}^{14}(d, p)\text{N}^{15}$. By combining the Ne^{20} and Ne^{21} data, the mass of $\text{Ne}^{21} = 21.00062 \pm 0.00015$. The 7.96 MeV group shows that Ne^{22} has an excited state at 1.39 ± 0.15 MeV. T. G. PICKAVANCE

539.172 : 778.3

7491. The possibility of electromagnetic excitation of the nuclei in photographic emulsions by light fast nuclei. B. D'ESPAGNAT. *C.R. Acad. Sci., Paris*, **230**, 1268-70 (March 27, 1950) *In French*.

Theoretical. The question is investigated as to whether a stationary atomic nucleus can be excited by electromagnetic interaction with a fast highly ionized atom passing near it, or whether a "direct hit" is necessary. On the basis of present hypotheses, it is concluded that the latter possibility is far more likely. W. F. BERG

539.172.1

7492. Recoil coincidence-absorption measurement of neutron spectra from the reactions $\text{A}^{40}(d, n)$ and $\text{N}^{15}(d, n)$. D. C. WORTH. *Phys. Rev.*, **78**, 378-81 (May 15, 1950).

A counter method offering a more convenient and flexible measurement of neutron energy in the medium- to high-energy range is further described. Experimental results obtained by the application of this method to the reactions $\text{A}^{40}(d, n)$ and $\text{N}^{15}(d, n)$ are given. For the A reaction, Q -values of 5.97, 4.63, 2.87 and 1.57 MeV were observed. The $\text{K}^{41}\text{-A}^{40}$ mass difference was thus observed to be 0.99936 ± 0.00027 m.u. For the N reaction, Q -values of 10.9, 4.8, 1.6 and 0.2 MeV were observed, the last value being in some doubt. A.

539.172.1

7493. The angular distribution of protons from the D-D reaction at 10 Mev. H. A. LEITER, F. A. RODGERS AND P. G. KRUGER. *Phys. Rev.*, **78**, 663-7 (June 15, 1950).

The gas-filled scattering chamber has been applied to the study of the distribution in angle of the protons from the (d, d) reaction with 9.94 ± 0.08 MeV deuterons from the cyclotron. Photographic plates were used as detectors. The other charged particles produced in the reaction and from scattering processes were prevented from reaching the emulsion by covering the photographic plates with a 53.2 mg/cm²

Al foil. Differential cross-sections were determined at 10° intervals from 15° to 65° in the laboratory system. Background runs were made to determine the correction necessary because of the flux of neutrons in the chamber. Additional corrections were made for the penetration of the protons through the edges of the defining slit and for geometrical errors. The total cross-section for the production of protons was calculated to be 7.3×10^{-26} cm². A.

539.172.

7494. The D-D reaction as a standard neutron source. K. G. MCNEILL, P. C. THONEMAN AND F. V. PRICE. Letter in *Nature, Lond.*, **166**, 28 (July 1, 1950).

539.172.11

7495. Proton groups from the alpha-particles bombardment of beryllium. W. O. MCMINN, M. B. SAMPSON AND M. L. BULLOCK. Letter in *Phys. Rev.*, **78**, 296-7 (May 1, 1950).

539.172.11

7496. Neutron groups from $\text{Be}^9(\alpha, n)\text{C}^{12}$. C. E. BRADFORD AND W. E. BENNETT. Letter in *Phys. Rev.*, **78**, 302-3 (May 1, 1950).

539.172.11

7497. The energy spectrum of neutrons from a Po-Be source. B. G. WHITMORE AND W. B. BAKER. *Phys. Rev.*, **78**, 799-801 (June 15, 1950).

This has been determined by the photographic emulsion method. The results agree, on certain assumptions, with the existence of energy levels in the C^{12} nucleus at 2.5, 4.5 and 7.1 MeV. The last 2 of these are consistently found by other workers, but the existence of the first is sometimes disputed. Possible reasons for the apparent discrepancies in the evidence on this point are discussed. A.

539.172.13

7498. Excitation curve for protons in the reaction $\text{F}^{19}(d, p)\text{F}^{20}$. S. C. SNOWDON. Letter in *Phys. Rev.*, **78**, 299-300 (May 1, 1950).

539.172.3

7499. Theory of the photodissociation and formation of H_3 and He_3 . M. VERDE. *Nuovo Cim.*, **7** (No. 3 bis), 283-306 (May, 1950) *In Italian*.

The cross-sections for dissociation, both into a deuteron and a nucleon, and into 3 nucleons, are calculated under the hypothesis that the wave function of the ground state is symmetrical in the space co-ordinates. Then photomagnetic dissociation is forbidden and the electric dipole interaction leads to an angular distribution following a $\sin^2 \theta$ law. The total cross-section is found to reach a maximum of about 5×10^{-28} cm² at an energy of the incident quantum of about 15 MeV. L. PINCHERLE

539.172.3

7500. Evidence for the photodisintegration of copper with proton emission. R. CHASTEL. *C.R. Acad. Sci., Paris*, **230**, 2020-2 (June 5, 1950) *In French*.

The photographic plate technique was employed. A thick sheet of Cu (359 mg/cm²) was irradiated by γ -rays produced in the bombardment of Li by 500 keV protons. The Cu was sandwiched between the emulsions of 2 plates, which were protected from the X-rays of the accelerator by 6 mm of Pb. The γ -ray flux through the plates was estimated from the

number of C photodisintegrations observed in the experiment. Corrections were made for protons produced by spurious causes. The maximum energy of the photoprotons was found to be 8 to 9 MeV, and a value of $1.0 \times 10^{-27} \text{ cm}^2$ deduced for $\sigma(\gamma, p)$.

L. R. SHEPHERD

539.172.3

01. Deuteron photo-effect at high energies.

I. SCHIFF. *Phys. Rev.*, **76**, 733-7 (June 15, 1950).

The cross-section for the photoelectric disintegration of the deuteron by gamma-rays with energies in the range 20 to 140 MeV is calculated for various assumptions as to the interaction between neutron and proton. This interaction is taken to be central, self-exchange and half-direct, of approximately Yukawa and exponential forms, and with 2 effective ranges; experimental data thus far obtained on neutron-proton processes do not provide a firm basis for distinguishing between these assumptions. Only the electric dipole and electric quadrupole cross-sections are found, since the magnetic dipole cross-section cannot be obtained reliably without explicit reference to a meson theory of nuclear forces. Use is made of a method for approximating to "long-tailed" potentials in such a way that the deuteron wave equation can be solved in simple analytic form. The results show relatively little difference between Yukawa and exponential potentials of the same effective range, either as to total cross-section or angular distribution, but an appreciable difference from earlier calculations with a square-well potential, and a dependence on effective range. It is shown that at very high energies, each photoelectric multipole cross-section depends primarily on the coefficient of the lowest odd power of r in the expansion of the deuteron potential about the origin.

A.

539.172.3 : 539.18

7502. Evidence for the production of neutral mesons by photons. J. STEINBERGER, W. K. H. PANOFSKY AND J. STELLER. *Phys. Rev.*, **78**, 802-5 (June 15, 1950).

In the bombardment of nuclei by 330 MeV X-rays, multiple gamma-rays are emitted. From their angular correlation it is deduced that they are emitted in pairs in the disintegration of neutral particles moving with relativistic velocities and therefore of intermediate mass. The neutral mesons are produced with cross-sections similar to those for the charged mesons and with an angular distribution peaked more in the forward direction. The production cross-section in H and the production cross-section per nucleon in C and Be are comparable.

A.

539.172.4

7503. Table for calculating activities produced by thermal neutrons. F. E. SENFLE AND W. Z. LEAVITT. *Nucleonics*, **6**, 54-63 (May, 1950).

Saturation activities (in rutherfords per gm) are tabulated for a large number of elements irradiated in a thermal neutron flux of $10^9 \text{ n/cm}^2/\text{sec}$. Activities produced per second irradiation are also listed. The table is supplemented by a graph giving growth and decay factors.

L. R. SHEPHERD

539.172.4

7504. Preparation of transplutonium isotopes by neutron irradiation. A. GHIORSO, R. A. JAMES,

L. O. MORGAN AND G. T. SEABORG. Letter in *Phys. Rev.*, **78**, 472 (May 15, 1950).

539.172.4

7505. Symmetrical tripartition of U^{235} by thermal neutrons. L. ROSEN AND A. M. HUDSON. *Phys. Rev.*, **78**, 533-8 (June 1, 1950).

An ionization chamber divided into three sections and triple coincidence circuit were used. Triple fissions occur to the extent of 6.7 ± 3.0 per 10^6 binary fissions in the case where the fragments come off with comparable masses.

A.

539.172.4

7506. Disintegration of neon by fast neutrons. C. P. SIKKEMA. Letter in *Nature, Lond.*, **165**, 1016-17 (June 24, 1950).

ATOM AND MOLECULE BEAMS . MESONS . NEUTRONS 539.18

539.18

7507. The observability of the C-meson. S. OGAWA. *Progr. Theor. Phys.*, **5**, 72-5 (Jan.-Feb., 1950).

The neutral scalar field introduced by Pais to eliminate quantum electrodynamic divergences is called the C-meson field. Assuming it to exist, the additional energy loss of fast charged particles in passing through matter is evaluated, and compared with underground cosmic-ray observations. The mass of the C-meson should be $\sim 500 m_e$, and should decay into an electron pair.

E. P. GEORGE

539.18

7508. The decay of a $\tau^\pm$ meson into $\pi^\pm$ and π_0 meson. H. FUKUDA AND Y. MIYAMOTO. Letter in *Progr. Theor. Phys.*, **5**, 147-8 (Jan.-Feb., 1950).

539.18

7509. The decay of a $\tau^\pm$ meson into a $\pi^\pm$ meson and a photon. H. FUKUDA AND Y. MIYAMOTO. Letter in *Progr. Theor. Phys.*, **5**, 148-50 (Jan.-Feb., 1950).

539.18 : 537.531

7510. Meson production by X-ray. Z. Koba, T. KOTANI AND S. NAKAI. Letter in *Progr. Theor. Phys.*, **5**, 137-8 (Jan.-Feb., 1950).

539.18 : 537.591.1

7511. Magnetic deflection of cosmic-ray mesons using nuclear plates. I. BARBOUR. *Phys. Rev.*, **78**, 518-25 (June 1, 1950).

Two nuclear plates, with an air gap separating their parallel emulsion surfaces in a perpendicular magnetic field, were used to obtain magnetic deflection measurements on cosmic-ray mesons near the top of the atmosphere. The signs of the charges of particles were determined, and confirmation obtained for the negative charge of σ -(star-producing) mesons, positive charge for π and μ (observed disintegration), while both signs were observed for ρ -mesons (stopping without visible interaction). The relative abundances of the different meson types were investigated. In the most favourable case a probable error of 15% in the mass determination was given. The values obtained were, for π - and σ -mesons, 270 ± 20 ;

for μ and ρ , 226 ± 15 . No evidence for light or very heavy mesons has been found so far. A.

539.18 : 537.542

7512. The detection of artificially produced photo-mesons with counters. J. STEINBERGER AND A. S. BISHOP. Letter in *Phys. Rev.*, **78**, 493-4 (May 15, 1950).

539.181

7513. Use of radio-elements in the investigation of transition and critical temperatures of molecular jets on surfaces. G. RIBAUD AND M. DEVIENNE. *C.R. Acad. Sci., Paris*, **230**, 1811-12 (May 22, 1950) In French.

A jet of radio-active Sb (isotopes 122 and 124) is evaporated from an oven, and falls on a glass plate, the apparatus being maintained at a pressure $\sim 10^{-5}$ mm Hg. When the glass is at 73°C , some Sb is deposited and some reflected; detection is by Geiger counter. When the glass is at oven temperature no Sb is deposited.

N. CORCORAN

539.181.2

7514. Method of producing molecular beams. D. L. SIMONENKO. *J. Exp. Theor. Phys., USSR*, **20**, 385-9 (May, 1950) In Russian.

The principle of the method consists in neutralizing ionic beams by intense electron currents, at right angles to the direction of propagation of the ionic beam. Intense beams of homogeneous velocity can so be obtained; the velocity of the beam can be controlled within wide limits by varying the accelerating potential of the ion source. The apparatus is described and a curve of variation of the density of the ion current v . density of the perpendicular electron current presented. The intensity indicator is a two-chamber Pirani manometer, with a sensitivity sufficient for detecting a neutralized ion beam of 1.3×10^{-7} A/cm², i.e. of a flow of neutral atoms of the order 1.07×10^{-12} mole/cm² sec. The fine slot of the indicator gives an absolute sensitivity of 1.9×10^{-16} mole/sec.

B. F. KRAUS

539.185

7515. Scattering of 90 MeV neutrons by alpha particles. Calculations. J. HEIDMANN. *C.R. Acad. Sci., Paris*, **230**, 724-5 (Feb. 20, 1950) In French.

Summarizes calculations made on the interaction between 90 MeV neutrons and α -particles using Wheeler's model of the α -particle, Born's approximation and Serber's nucleon-nucleon potential. Three transitions are considered: elastic scattering, formation of a proton and formation of a deuteron. Other modes (e.g. disintegration of the α -particle to two deuterons) are neglected. The total cross-section is given as $2.4 \pm 0.2 \times 10^{-25}$ cm².

J. THEWLIS

539.185

7516. The neutron density near a plane surface in a capturing medium. J. LECAINE. *Canad. J. Res. A*, **28**, 242-67 (May, 1950)

The variational method is applied to the Milne problem with capture, to obtain, for the density and for the angular distribution, expressions which give quite accurate values and which have a relatively simple analytical form. Tables of the density and

angular distribution are included. The extrapolation distances determined by the variational method agree to high accuracy with the exact values. The angular distribution determined by the variational method is shown to be accurate within 0.05% in all cases where exact results are available. Tables are also given for the density and angular distribution in the Milne problem with capture and constant production. A.

539.185

7517. Angular distribution of neutrons at the interface of two adjoining media. B. DAVISON. *Canad. J. Res. A*, **28**, 303-14 (May, 1950).

Two media separated by a plane interface and each filling an infinite half-space are considered. Neutrons come in infinite number from infinity in one medium and the neutron density vanishes at infinity in the other medium. Isotropic scattering in the laboratory system of co-ordinates in both media is assumed and all neutrons are assumed to have the same speed. The angular distribution of neutrons emerging from either medium into the other is obtained in terms of the angular distribution of neutrons for the Milne problem, that is, the angular distribution of neutrons emerging from a scattering medium into a vacuum. The latter angular distribution is tabulated in the paper by LeCaine [Abstr. 7516 (1950)]. A.

539.185

7518. Pile neutron research techniques. II. D. J. HUGHES. *Nucleonics*, **6**, 38-53 (May, 1950).

Experimental uses for the large thermal neutron fluxes and beams available in thermal reactors. The techniques which are described include: the measurement of neutron activation cross-sections; determination of absorption cross-sections by pile reactivity methods and by diffusion length measurement ($\sigma_s \gg \sigma_a$); observation of short-lived activities by irradiation in beams emerging from a pile; observation of instantaneous radiations arising from neutron capture; production of monokinetic neutrons using the crystal spectrometer or mechanical velocity selector in a pile neutron beam; uses of neutrons in crystal spectrometry; production of polarized neutron beams by transmission through magnetized iron blocks and the utilization of this phenomenon to investigate ferromagnetic properties; total reflection of highly collimated thermal neutron beams from polished surfaces at glancing angles of a few minutes and some of the applications of this effect.

L. R. SHEPHERD

539.185

7519. A lower bound on the range of the triplet neutron-proton interaction. L. L. FOLDY. Letter in *Phys. Rev.*, **78**, 636 (June 1, 1950).

539.185 : 538.245

7520. Remarks on the magnetic scattering of neutrons. H. EKSTEIN. *Phys. Rev.*, **78**, 731-2 (June 15, 1950).

The formal calculation of the scattering of neutrons by a magnetized atom leads to a result which is ambiguous in the forward direction. It is shown that, if this singularity is correctly taken into account, apparent discrepancies between macroscopic and atomistic calculations are eliminated. A.

539.185.08 : 537.542

Intillation counter for neutrons. See Abstr. 7323

539.185.7 : 519.283

Random sampling (Monte Carlo) techniques for neutron attenuation problems. I. H. KAHN. *Nucleonics*, **6**, 27–33, 37 (May, 1950).

The evaluation of integrals by random sampling is simpler than numerical computation. In the case of multiple integrals the method is less laborious than numerical computation. The probability that a particle penetrates a shield with n collisions involves a multiple integral of order $3n$, and this suggests that the process of random sampling might be of value in evaluating the probability of penetration. In treating the attenuation problem by statistical methods one can deal with the probability of each collision separately and hence proceed to estimate the probability of a given sequence of collisions. This is a straightforward analogue of the actual physical situation, but it fails for the large attenuation factors (10^{-6} to 10^{-9}) involved in shielding problems because of the large number of samples which must be taken (10^9 to 10^{15}) to obtain a reasonable probable error. Possible techniques for overcoming this difficulty and obtaining, say, 10% accuracy with only 10^3 samples are listed.

L. R. SHEPHERD

539.185.7 : 537.542

22. Evaluation of neutron counter efficiency. E. DRAPER. *Nucleonics*, **6**, 32–40 (March, 1950). The neutron absorption rate in a long cylindrical BF_3 -filled counter, embedded in an infinite paraffin medium, is estimated. The radius of the BF_3 counter is assumed to be $\ll$ capture m.f.p. of thermal neutrons in the BF_3 filling. A constant rate of production of thermal neutrons throughout the medium is assumed and an expression is derived for the counter absorption rate in terms of parameters which are evaluated for various filling pressures and cylinder radii. The counter wall is assumed to be replaced by free space in the calculation, the errors arising from this assumption being estimated for the case of a brass wall.

L. R. SHEPHERD

539.185.7 : 539.152.1

23. Total cross section of C, O, Mg, Si and S for fast neutrons. G. FREIER, M. FULK, E. E. LAMPI AND H. WILLIAMS. *Phys. Rev.*, **78**, 508–12 (June 1, 1950). The total cross-sections of light nuclei containing an integral number of alpha-particles was found by measuring the transmission of C, Mg, Si, S and SiO_2 samples for fast neutrons in the energy range 0.60 to 90 MeV and in the energy range 2.5 to 5.0 MeV. The cross-sections have many resolved resonances, and the number of resonances per unit energy range increases rapidly with atomic number.

A.

STRUCTURE OF SOLIDS 539.2

539.21

24. Passivation of metals. R. SPEISER, F. H. JACK, M. G. FONTANA AND E. N. LASSETTIE. Letter *J. Chem. Phys.*, **18**, 772–3 (May, 1950).

539.211

7525. An absolute measurement of copper-copper interfacial free energy. G. W. SEARS. Letter in *J. Appl. Phys.*, **21**, 721 (July, 1950).

539.213.2 : 535.32

7526. The variation of the optical properties with glass structure. N. J. KREIDL. *Acta Phys. Austriaca*, **3** (No. 4) 405–17 (1950) In German.

The formation of glasses with high lead oxide content can be explained by the usual lattice theory modified by an asymmetrical electron structure. This electron asymmetry can also be related to the variation of molecular refraction with the cations present, the temperature and time of annealing. Experimental results for the variation of molecular refraction, refractive index and density, with glass composition and state of annealing are reviewed, 27 references being given.

R. W. FISH

539.215 : 548.535

Dislocation models of crystal grain boundaries. See Abstr. 7592

539.217

7527. Measurement of self-diffusion of silver without radioactive tracers. G. C. KUCZYNSKI. *J. Appl. Phys.*, **21**, 632–5 (July, 1950).

A new method dispensing with the use of radioactive tracers has been developed for measurement of volume self-diffusion. The method is based upon the relationship of the rate of sintering of metallic wires to the coefficients of self-diffusion. The values of the self-diffusion coefficients for Ag as measured by this method are in good agreement with those obtained by the radioactive tracer method.

A.

539.23 : 535.424

7528. Study of monomolecular films by phase contrast. M. FRANÇON, R. GENTY AND F. TABOURY. *C.R. Acad. Sci., Paris*, **230**, 2082–4 (June 12, 1950) In French.

A method of measuring the thickness of thin films deposited on glass or metal. Phase differences between light reflected from the film and an uncoated strip of the glass become intensity differences after phase contrast. This contrast difference, measured photometrically, enables the thickness to be deduced within 2 Å.

R. W. FISH

539.26

7529. X-ray measurement of long range order in β -brass. D. CHIPMAN AND B. E. WARREN. *J. Appl. Phys.*, **21**, 696–7 (July, 1950).

The long-range order in β -brass was determined by measuring the integrated intensity of the (100) superstructure reflection from a single crystal held at various temperatures. With a single crystal, and Cu-K α -radiation obtained by a balanced Ni-Co filter, there is ample intensity for measurement with a Geiger-counter spectrometer. The measured long-range order parameter S is in satisfactory agreement with the theoretical predictions.

A.

539.269

7530. A test of the interpretation of X-ray patterns of micelles. E. W. HUGHES. Letter in *Nature, Lond.*, **165**, 1017 (June 24, 1950).

539.27
7531. **Metallic evaporation and the diameter of tobacco mosaic virus with the electron microscope.** H. KAHLER AND B. J. LLOYD, JR. *J. Appl. Phys.*, **21**, 699-704 (July, 1950).

Tobacco mosaic virus has been used as a known test object for the intercomparison of several methods of small particle measurements, all involving metallic evaporation. Various characteristics of these methods, which determine their accuracy, were investigated. Measurement of groups and the derivation of a mean size therefrom is primarily limited in accuracy only by the exactness of juxtaposition of the successive particles in the group. The measurement of the images of single particles is subject to the relatively large error associated with the uncertainty in the relationship between the true particle edge and the image of the edge which has received a coating of metal. The measurement of shadow lengths reduces this error by the factor $2 \tan \alpha/2$. A symmetrical shadow method is described which reduces the error of substrate tilt, and is insensitive to amount of metal deposited. An average over the four best methods gave a value $150.0 \pm 3.6 \text{ \AA}$ agreeing closely with the X-ray determination.

A.

539.27
7532. **The apparent size of objects as observed in the electron microscope.** S. F. KERN AND R. A. KERN. *J. Appl. Phys.*, **21**, 705-7 (July, 1950).

The image formed in the electron microscope of shadowed polystyrene latex spheres is larger than the image of unshadowed spheres. This increase in image size and probable causes are discussed. Implications of this phenomena on the study of viruses and other biological specimens are mentioned.

A.

539.27
7533. **The use of critical point phenomena in preparing specimens for the electron microscope.** T. F. ANDERSON. Letter in *J. Appl. Phys.*, **21**, 724 (July, 1950).

The water in the specimen is replaced by stages by a liquid with a conveniently low critical point. Heating in a bomb completely filled with this liquid converts the liquid to gas without danger of distorting the specimen by passage through it of a phase boundary.

ELASTICITY . STRENGTH : RHEOLOGY 539.3/8

539.319
7534. **Stress analysis for compressible viscoelastic materials.** W. T. READ, JR. *J. Appl. Phys.*, **21**, 671-4 (July, 1950).

Mathematical methods of stress analysis are presented for linear, compressible, viscoelastic, or anelastic materials such as metals at high temperatures or high polymers with small strains. For such materials stress, strain and their time derivatives of all orders are related by linear equations with coefficients which are material constants. Fourier integral methods are used to show that static elasticity solutions can be used to determine the time-dependent

stresses in viscoelastic bodies with any form boundary conditions. If stress and double refractive and their time derivatives are also linearly related, the standard photoelastic techniques can be used to determine the directions and difference in magnitude of the time-dependent principal stresses, even though the principal stress axes do not coincide with the polarization axes and both vary with time. When viscoelastic models are used in photoelastic studies, the time variation of the stress distribution in the model represents a first approximation to the dependence of the stress in the elastic prototype on Poisson's ratio.

539.32

7535. **Impulse-phase method of determining the mechanical parameters of resin-like materials.** M. A. ISAKOVICH. *J. Exp. Theor. Phys.*, **USSR**, **20**, 371-2 (April, 1950) *In Russian*.

The widely used resin-like materials of modern technology (natural and artificial rubbers and plasticized artificial resins) all imitate the mechanical characteristics of natural rubbers, i.e. the small value of their shear modulus and their high internal viscosity. The shear modulus of these substances is thousands of times greater than the bulk modulus which is of the same order as that of water. The elastic parameters of these substances vary within wide limits, depending on chemical composition, technology of production, temperature and frequency of the external force. The theory of a measuring method of the elastic parameters is developed, and a testing method based on it described. This works with short wave-trains of acoustic waves set up in an impulse tube filled with water, in which the sample is immersed. It is shown theoretically that the determination of the wave modulus can be used to find the shear modulus of the material, which is confirmed by the actual test results. The rather laborious theoretical evaluation of the test results is simplified by using a graphical method.

B. F. KRAU

539.32

7536. **The anisotropy of Young's modulus of ferromagnetic monocystals.** N. S. AKULOV, I. P. MAZUR AND YA. E. FELDSHTEIN. *Dokl. Akad. Nauk, SSSR*, **71** (No. 5) 851-4 (1950) *In Russian*.

Shows the method for the determination of the elastic modulus for monocystals on the basis of measurements conducted on polycrystalline textured specimens and its application in the study of elastic properties of monocystals in Ni.

Z. F. WOJNA

539.32 : 5488

7537. **The elastic constants of sodium tartrate and Rochelle salt.** R. V. G. SUNDARA RAO. *Proc. Indian Acad. Sci. A.*, **30**, 173-80 (Oct., 1949).

The constants were determined by the ultrasonic method. The results are discussed along with the existing data on Rochelle salt.

539.32

7538. **On the theory of the screw dislocation.** C. LEIBFRIED AND H.-D. DIETZE. *Z. Phys.*, **126** (No. 10) 790-808 (1949) *In German*.

The structure of a screw dislocation in a plate is treated by two methods. An exact solution is obtained, using Peierls's hypothesis, in the case where

dislocation lies in the middle surface of the plate. For a dislocation moving with uniform velocity v , there is a "relativistic" dependence of the energy of the dislocation on the velocity: $E(v) = \frac{1}{2} D [1 - v^2/c^2]^{-\frac{1}{2}}$, where c is the velocity of a transverse sound wave. Under the influence of external forces, each a dislocation will practically always travel with the speed of sound.

J. G. OLDROYD

539.37

39. The measurement of the largest impact force. MINTROP. *Schweiz. Arch. angew. Wiss. Tech.*, **16**, 9-24 (April, 1950) In German.

The use of the Hertz theory of contact between elastic bodies is discussed as a means of measuring very large forces. Static calibration, the use of high-speed cameras to provide time measurements and the derivation of force-time curves are mentioned. A maximum pressure gauge developed by Zeiss and using this principle is described, and also its use to measure retardations.

G. O. BAINES

539.37 : 548.0

540. On the forces acting on a dislocation. G. REIBFRIED. *Z. Phys.*, **126** (No. 10-12) 781-9 (1949) In German.

The force on a simple dislocation is defined as the gradient of the energy associated with a dislocation, regarded as a function of the position of its centre. When the external stresses acting on a body are specified, the force on a dislocation within the body is completely determined by the stress at the centre of the dislocation and the magnitude of the dislocation. If the stresses on an internal surface of the body are specified, the problem is more complicated. The force on a dislocation due to a second dislocation, and the force due to the presence of a foreign atom in the crystal, are calculated.

J. G. OLDROYD

539.37 : 548.7

541. The theory of displacements in one-dimensional ionic lattices. I. Displacements in a periodic potential. A. KOCHENDÖRFER AND A. SEEGER. *Z. Phys.*, **127** (No. 5) 533-50 (1950) In German.

The following model is suggested for a discussion of the plastic deformation of a crystal. Atoms of a one-dimensional lattice are subject to a periodic potential with the period of the lattice, a , and may be displaced through distances α , ($\alpha \pm a$). The motion of an initially specified displacement through the lattice is calculated under the assumption that the variation of the displacement along the lattice is not great. The equations of motion are non-linear, and are solved in terms of elliptic integrals.

J. R. MADDOX

539.371

542. Finite strains in an anisotropic elastic continuum. J. G. OLDROYD. *Proc. Roy. Soc. A.*, **202**, 345-58 (Aug. 7, 1950).

The discussion in a previous paper [Abstr. 3443 1950] on the invariance properties required of the equations of state of a homogeneous continuum, is extended by taking into account thermodynamic restrictions on the form of the equations, in the case of an elastic solid deformed from an unstressed equilibrium configuration. The general form of the finite strain-stress-temperature relations, expressed in terms

of a free-energy function, is deduced without assuming that the material is isotropic. The results of other authors based on the assumption of isotropy are shown to follow as particular cases. The equations of state are derived by considering quasi-static changes in an elastic solid continuum; the results then apply to non-ideally elastic solids in equilibrium, or subjected to quasi-static changes only, and to ideally elastic solids in general motion. A necessary and sufficient compatibility condition for the finite strains at different points of a continuum is also derived. As a simple illustration of the derivation and use of equations of state involving anisotropic physical constants, the torsion of an anisotropic cylinder is discussed briefly.

A.

539.371

7543. Finite elastic deformation of incompressible isotropic bodies. A. E. GREEN AND R. T. SHIELD. *Proc. Roy. Soc. A.*, **202**, 407-19 (Aug. 7, 1950).

The theory of finite elastic deformation of incompressible isotropic bodies is expressed in a simple form in tensor notation, using a general system of coordinates which move with the body as it is deformed. In order to illustrate the advantages of the present methods one problem, previously solved by Rivlin, is re-examined. Two new problems are then solved using a completely general form for the strain energy function, the first problem being that of a rotating cylinder, and the second a uniform spherical shell under symmetrical internal and external pressures.

A.

539.374

7544. Theory of the mechanical properties of hot plastics. S. J. LORING. *Trans. Amer. Soc. Mech. Engrs*, **72**, 447-63 (May, 1950).

A theory of the mechanical behaviour of materials, such as hot plastics, which exhibit large strain elasticity and stress relaxation, is developed. The theory is applied to obtain general solutions for steady state flow in channels and in tubes. Comparison with experiment shows encouraging agreement with the theory.

G. O. BAINES

539.374

7545. A peculiarity of the mechanism of plastic deformation of ice. K. E. IVANOV AND V. V. LAVROV. *J. Tech. Phys., USSR*, **20** (No. 2) 230-1 (1950) In Russian.

It is shown that the plastic deformation curve of ice, just as those hitherto investigated of NaCl, brass, Zn and Cd crystals, and also metals in semi-crystalline state, has a marked stepped character. This applies for the first and subsequent stressings as well, which furnish families of curves of essentially identical character. The difference from curves of metals consists in the dimension of the steps, which for metals is 10μ , for ice $50-100\mu$. The experiments were made at -3°C , the repeated stress being applied to the same specimen after a 21 hr rest.

B. F. KRAUS

539.374

7546. Micrographic study of the plastic deformation of α -brass. Application to surface abrasion structures. P. A. JACQUET. *Rev. Métall.*, **47**, 355-64 (May, 1950) In French.

An account of an electrolytic etching technique

useful in the metallographic study of slip bands in cold worked α -brass. The method has been used to investigate the deformation produced near the surface by abrasion. The effects of deformation have been observed at greater distances below the surface than hitherto.

M. R. HOPKINS

539.374 : 539.382

7547. A quantitative comparison of flow and deformation theories of plasticity. P. G. HODGE, JR. AND G. N. WHITE, JR. *J. Appl. Mech.*, **17**, 180-4 (June, 1950).

The stresses and displacements in a partly plastic, infinitely long, hollow cylinder are obtained according to the flow type of stress-strain law of Prandtl-Reuss and to the deformation law of Hencky. In both cases the Mises yield condition is used and the compressibility of the material is taken into account. It is shown that under these assumptions the two theories yield substantially the same results for this particular problem, but that one theory or the other may be preferable for computing purposes in certain cases. The results are compared with those of other investigations in which different combinations of stress-strain law, yield condition, compressibility, and end loading were assumed.

A.

539.375 : 548.0

Investigation of the critical shear stress for single crystals of metallic solid solutions. See Abstr. 7585

539.389.3 : 536.7

7548. Theory of relaxation phenomena in solids. B. N. FINKELSHEIN AND N. S. FASTOV. *Dokl. Akad. Nauk, SSSR*, **71** (No. 5) 875-8 (1950) *In Russian*.

The theoretical investigation of these phenomena was hitherto based on a formal extension of the elastic theory by introducing terms depending on time into the generalized Hooke equation, or on Boltzmann's theory of the elastic after-effect. The present attempt is based on general thermodynamical considerations by a method first used by L. I. Mandelstam and M. A. Leontovich [*J. Exp. Theor. Phys.*, **7**, 438 (1937)] in the theory of sound absorption in liquids. If the stressed state in an elastic body is propagated at a finite velocity, there is at any time a deviation from the statistical equilibrium throughout the body. The deformation process becomes hereby irreversible and the dissipated elastic energy is converted into heat. The instantaneous deviation of the state of the body from the statistical equilibrium may be characterized by the relaxation tensor ξ_{ik} . This representation is used in the paper for the special case of isothermal changes of state. The free energy of the isotropic elastic body may then be represented by a linear combination of the quadratic invariants of the elastic tensor ϵ_{ik} and relaxation tensor ξ_{ik} . The resulting elastic waves are found. Their propagation velocity appears as a monotonic function of the frequency, on which also depends their absorption.

B. F. KRAUS

539.4.016

7549. On the effective range of stress hardening. A. SLIBAR AND F. VITOVEC. *Schweiz. Arch. angew. Wiss. Tech.*, **16**, 80-4 (March, 1950) *In German*.

The hardening is assumed to be due to the interference of crystallites with one another; the latter

depends on the angle (θ) between the crystallographic axes of the crystallites and their separation. The limitation of the deformation of a single crystallite by its neighbours is shown to be a function of the crystallite dimensions, and for face-centred cubic materials, using experimental results, the mean θ is calculated to be 0.57×10^{-5} radians.

J. E. CAFFRY

539.4.016.3

7550. Anomalous internal friction associated with the precipitation of copper in cold-worked Al-Cu alloys. T.-S. KÉ. *Phys. Rev.*, **78**, 420-3 (May 15, 1950).

539.44

7551. Test of rupture strength of thin plastic films. J. J. L. CHEN. Note in *Rev. Sci. Instrum.*, **21**, 491- (May, 1950).

539.42 : 539.211

7552. Interpretation of fracture markings. J. A. KIES, A. M. SULLIVAN AND G. R. IRWIN. *J. Appl. Phys.*, **21**, 716-20 (July, 1950).

This paper presents a study of the sequence of events by which cracks "grow." A careful investigation was made of the origin, development and characteristic pattern of level-difference markings left by rapidly moving fractures in a wide variety of materials. Characteristic markings indicating discontinuous propagation are found in fractures of plastics, polycrystalline and single-crystal materials: coal, mica, photographic film from which the emulsion was stripped, etc. Thus, the continued occurrence of essentially discontinuous initiations which comprise fracturing becomes clear. These considerations are sufficient to explain a number of well-known fracture markings and to clarify what is meant by brittleness and fracture velocity.

539.434 : 548.0

7553. An unusual effect in the creep of zinc single crystals. L. SLIFKIN AND W. KAUFMANN. Letter in *Phys. Rev.*, **78**, 631-2 (June 1, 1950).

539.434 : 548.0

Surface effects in the creep of cadmium single crystals. See Abstr. 7586

539.61 : 532.63

7554. Adhesion of solids and the effect of surface films. J. S. MCFARLANE AND D. TABOR. *Proc. Roy. Soc. A*, **202**, 224-43 (July 7, 1950).

Earlier experiments have shown that the friction between metals is due to the shearing of junctions formed by adhesion or welding at the points of intimate contact. This suggests that when the load is removed the junctions should remain and an appreciable normal force should be needed to separate the surfaces. Experiments show that with clean hard surfaces in dry air the adhesion is negligibly small. In moist air appreciable adhesion may be observed and it is shown that this is due to the surface tension of a thin film of adsorbed water. The surface-tension forces due to thin films of liquid trapped between solid surfaces may be very large. Under certain conditions the viscosity of the liquid may also be important. The absence of adhesion between clean hard surfaces is not due to the non-formation of metallic junctions. Experiments show that it is due to the released elastic stresses which break the junctions one by one as the load is removed. With very soft metals, such as Pt

In, where the effect of released elastic stresses is much less important, marked adhesion is observed. If the surfaces are freed of grosser contaminants, adhesion provides direct evidence for the formation of metallic junctions by a process of cold welding pressure welding at the points of contact. If the surfaces are covered with oxide films of appreciable thickness, the amount of metallic interaction is diminished with a corresponding reduction in the adhesion. Lubricant films have a similar effect, and in general those materials which are most effective in reducing the adhesion are also most effective, as boundary lubricants, in reducing the friction. A.

539.61 : 539.62

55. Relation between friction and adhesion. S. MCFARLANE AND D. TABOR. *Proc. Roy. Soc. A*, **12**, 244-53 (July 7, 1950).

Simultaneous measurements have been made of the friction and adhesion of steel sliding on In in air. The results show that both the normal and tangential stresses play a part in the deformation of the metallic junctions formed at the interface. When the surfaces

are first placed in contact, a minute tangential force is required to initiate relative motion between the slider and the In surface, since the junctions are already plastic under the applied load. As relative motion proceeds, the region of contact grows with a corresponding increase in the tangential force and the adhesive force. An upper steady state is reached where the tangential force increases more rapidly than the rate of growth of the region of contact and sliding on a macroscopic scale occurs. The detailed behaviour of the junctions during the early stages of the sliding process may be expressed quantitatively in terms of von Mises's criterion for plastic deformation under combined normal and tangential stresses, and there is good agreement between the theoretical relation and the experimental observations. The results emphasize the reality of the cold welding process which occurs at the points of intimate contact when metal surfaces are placed together. The metallic junctions so formed are responsible both for the friction and the adhesion observed. Lubricant films diminish the amount of metallic contact and so lead to a reduction in the friction and adhesion. A.

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM . CHEMICAL REACTIONS 541.11/12

541.124

556. The kinetics of the interaction of atomic hydrogen with olefines. V. Results obtained for a further series of compounds. H. W. MELVILLE AND C. ROBB. *Proc. Roy. Soc. A*, **202**, 181-202 (July 7, 1950).

See Abstr. 3524-7 (1949). In this paper the efficiency of interaction of a H atom with a series of olefines has been determined, the olefines being members of the series obtained by progressively replacing the H atoms of ethylene by methyl radicals. The interesting generalization which emerges from this is that the efficiency of interaction does not vary very much with the nature of the alkyl substituents in the molecule, and calculations involving the heats of addition of a H atom to a double bond confirm this generalization. The data presented here are discussed critically in relation to information available on the reaction of CCl_3 radicals with olefines and of alkyl radicals with olefines, complete general agreement being demonstrated. A.

541.124 : 534.39

Chemical action of sound waves on aqueous solutions. See Abstr. 7090

541.126

7557. An experimental contribution to the study of the mechanism of explosion of ammonium nitrate. A. H. DELSEMME. *C.R. Acad. Sci., Paris*, **230**, 1858-60 (May 22, 1950) In French.

Light from a H lamp was allowed to pass through a closed vessel in which approx. 5 g of NH_4NO_3 was slowly heated to its explosion temp. (290°C). The spectrum of the emergent light was observed at

intervals: it consists of a continuum on which are superposed bands, the intensity of which vary as the heating proceeds. The bands of NO and NH_3 were examined in detail. For very dry nitrate (< 0.1% water) the NO bands are intense between 270°C and 280°C, decreasing betw. 280-290°C, while the NH_3 bands reach their max. intensity betw. 280-290°C. When the nitrate is imperfectly dried (approx. 0.4% water) the NO bands never become intense, but the NH_3 bands are intense over a wider range (270-290°C). It is suggested that the presence of water catalyses decomposition into NH_3 and HNO_3 to the detriment of NO formation; and that because the formation of NH_3 is endothermic, decomposition of this type is less likely to lead to explosion.

A. SCHOFIELD

541.126

7558. Mechanism of ignition by local sources of heat. H. P. STOUT. Letter in *Nature, Lond.*, **166**, 28-9 (July 1, 1950).

ELECTROCHEMISTRY 541.13

541.132

7559. On the distribution of ions in solutions of strong electrolytes. M. DUTTA AND S. N. BAGCHI. *Indian J. Phys.*, **24**, 61-6 (Feb., 1950).

In a recent paper it has been shown that a better and closer agreement between the theoretical and the experimental values of activity coefficients are obtained, if instead of Boltzmann's distribution functions a new distribution function, similar in form to that of Fermi-Dirac, be used in the Debye-Hückel theory of strong electrolytes. No deduction has been given yet

for the function used by Bagchi. In this paper, the distribution function has been deduced from simple physical properties of ions by a method developed by Dutta.

A.

541.135.5

7560. The kinetics of hydrogen evolution. J. O'M. BOCKRIS, R. PARSONS AND H. ROSENBERG. Letter in *J. Chem. Phys.*, **18**, 762-3 (May, 1950).

Comment is made on certain conclusions of Van Rysseberghe [see Abstr. 3458 (1950)], viz. (1) that the rate of discharge of H ions is not dependent upon the immediate product of the reaction, which is contrary to the experimental evidence; (2) the suggestion on theoretical grounds of the existence of several "Tafel regions," which is disputed; and (3) that overpotential is in the general case independent of H ion concentration, and in special cases dependent on it, whereas under satisfactory experimental conditions the reverse situation is observed.

H. H. HODGSON

PHOTOCHEMISTRY . RADIATION CHEMISTRY 541.14

541.14

7561. Radiation chemistry of ferrous-ferric systems. C. B. AMPHLETT. Letter in *Nature, Lond.*, **165**, 977-8 (June 17, 1950).

541.14

7562. Chemical reactions of energetic chlorine atoms produced by neutron capture in liquid systems. J. M. MILLER AND R. W. DODSON. *J. Chem. Phys.*, **18**, 865-75 (June, 1950).

The fraction of the radioactive energetic Cl atoms, formed by radiative neutron capture, that react with inactive CCl_4 to give radioactive CCl_4 , or with a solvent to give other radioactive organic halides, was studied as a function of composition in solutions of CCl_4 in SiCl_4 , cyclohexane and benzene. The reactions of similarly formed atoms were also studied for solutions of Cl in cyclohexane and in benzene. No significant effect of the temperature of the bombarded solution or of the energy of the neutrons was found. The results are examined in terms of a theory which predicts the concentration-dependence of some of the observed reactions, and alternative descriptions are suggested. It is concluded that the observed reactions occur before the recoil atoms are reduced to thermal equilibrium, and that particular reactions predominate in certain energy ranges.

A.

541.14

7563. Chemical kinetics of bromine following neutron capture. R. R. WILLIAMS, JR. AND W. H. HAMILL. *J. Chem. Phys.*, **18**, 783-8 (June, 1950).

The kinetic behaviour of Br^{80} produced by neutron capture has been investigated in gaseous systems containing ethyl bromide, ethylene and hydrogen bromide. The distribution of active bromine between organic and inorganic form has been shown to be principally dependent on the ethylene pressure. A kinetic scheme, incorporating a "hot atom" reaction, is

postulated and shown to be in agreement with the experimental facts. Additional experimental tests of critical points in the proposed scheme have been successful.

541.1

7564. Valencies of radio phosphorus extracted from alkaline chlorides irradiated by neutrons. R. CAILLAT AND P. SÜE. *C.R. Acad. Sci., Paris*, **230**, 1666-7 (May 8, 1950) In French.

Radiophosphorus formed in the reaction $\text{Cl}^{35}(n, \alpha)\text{P}^{32}$ in crystals of LiCl, NaCl, KCl is approximately divided between the pentavalent (P^{5+}) and other ($\text{P}^{<5+}$) states. In sat. solns. of NaCl and KCl only P^{5+} was obtained.

A. O. STANESBURY

541.1

7565. Valencies of radiophosphorus in crystals of NaCl irradiated by neutrons, before and after decolorization. P. SÜE AND R. CAILLAT. *C.R. Acad. Sci., Paris*, **230**, 1864-5 (May 22, 1950) In French.

See preceding Abstr. The ratio $\text{P}^{5+}/\text{total P}$ in single crystals of NaCl irradiated with neutrons is $\sim 40\%$ in untreated crystals, but only $\sim 30\%$ in crystals decolorized by heating to 350°C after irradiation. It is assumed that electrons associated with the F-centres and released on heating reduce the P^{5+} to lower valency states.

A. O. STANESBURY

541.14 : 532.7

7566. Reactions of recoil atoms in liquids. J. M. MILLER, J. W. GRYDER AND R. W. DODSON. *J. Chem. Phys.*, **18**, 579-3 (May, 1950).

The reactions in liquid phase of the recoil atoms formed in the (n, γ) process are discussed in terms of a model involving energy loss by elastic collisions, dissociation of solvent molecules by impact, and eventual reaction in a liquid cage. Expressions are derived which relate the fraction of the recoil atoms ultimately found in a given molecular species to the composition and properties of the liquid. Previously published data are interpreted in terms of this model.

541.14 : 537.56

7567. Elementary processes in radiation chemistry. I. Some considerations of mechanism of electron capture. J.-L. MAGEE AND M. BURTON. *J. Amer. Chem. Soc.*, **72**, 1965-74 (May, 1950).

For purposes of this study, capture of an electron by a molecule or ion is treated as a non-adiabatic chemical process. Necessary potential energy curves are given for application of this method to H systems. A contour surface is calculated for the isosceles $\text{H}_2^+ + \text{H}$ system (plus an electron) and the intersections of that surface with the isosceles $\text{H}_2(^3\Sigma) + \text{H}$ and $\text{H}_2(^1\Sigma) + \text{H}$ surfaces have been calculated to a required degree of approximation. It is shown that probability of non-radiative capture of an electron by a positive ion exceeds that of radiative capture by a factor of 10^6 . Capture of an electron by normal H_2^+ leads with maximum probability to one normal and one excited H atom. Capture of an electron by normal H_3^+ considerably favours transition to the $\text{H}_3(^1\Sigma) + \text{H}$ state rather than to the $\text{H}_2(^3\Sigma) + \text{H}$ state because of a sensible activation energy difference between the two processes. No comparison is made with the

ability of transition to the system $H_2^* + H$, though it is shown that transitions of this class are important for complicated-molecule systems. The transition to $H_2(^1\Sigma) + H$ leads to immediate dissociation into 3 H atoms. Capture of an electron by isolated complicated-molecule ion appears to lead in most cases to immediate dissociation into 2 particles, one of which is excited. Dissociation into radicals is favored over dissociation into molecules. In the excited state the ultimate molecule mechanism increases in relative importance. A.

541.14 : 77.01

7571. The spontaneous regression of the photolysis of silver bromide. F. URBACH AND A. URBACH. *Ann. Phys. (Austria)*, 3 (No. 4) 422-47 (1950) In German.

Silver bromide sols show visible photolysis only in the presence of certain halogen acceptors. A number of experiments on sols containing hydroquinone are reported. The fading is increased by the addition of amide ions and of quinone, but does not depend on the presence of O. No visible emission of light accompanies fading. The discoloration of a sol on exposure to light seems to be due to the deposition of metallic Ag on the grain surfaces and is not altered if the Ag halide itself is dissolved. The presence of photolytic Ag produces a sensitizing (Becquerel) effect. Gelatine inhibits the fading, which seems to obey a first-order reaction law. W. F. BERG

DISPERSIONS . COLLOIDS . ADSORPTION

541.18

541.18 : 536.63

7572. The contribution of the surface of the specific adsorption of disperse systems. H. KOPPE. *J. Chem. Phys.*, 18, 638-40 (May, 1950).

A theory of Brager and Schuchowitzky is extended to the interfaces of binary systems. A.

541.182 : 532.6

7573. The lateral diffusion of a cloud of falling droplets. *See Abstr.* 7055

541.182.5 : 548.5

7574. Crystallization, by heating, of mixed gels of silica and magnesia. G. SABATIER. *C.R. Acad. Sci., Paris*, 230, 1962-4 (May 31, 1950) In French.

The gels are obtained by precipitating simultaneously SiO_2 and MgO from solutions of Na silicate and Mg chloride. Any desired composition may be obtained by varying the ratio of SiO_2 and Na_2O in the silicate. Phase diagrams are given showing temperature and heat of crystallization in their functional relation to the molecular percentage of the gels. By X-ray diffraction the constituents are identified as being forsterite and periclase for the mixtures containing more MgO , and enstatite and diopside for those containing more SiO_2 . The crystals are too small to be seen under a microscope. The heat of crystallization and the contraction of the gels are about proportional. No crystallized phase was found not already known by the study of the solid system SiO_2 - MgO . R. NEUMANN

541.182.6

7571. Size of particles of colloidal copper oxide. T. KIKINDA. *C.R. Acad. Sci., Paris*, 230, 1772-4 (May 15, 1950) In French.

The particle size of colloidal copper oxide was studied by small-angle X-ray diffraction. It was found to be fairly uniform and to increase with the concentration of the solutions (ammoniacal sulphate of copper) from which the specimens are prepared, if the solutions are kept dilute. For concentrated solutions, the particle size varies somewhat, but the smallest size observed increases with the speed of heating. The radius of gyration ranges from 14.4 to 24.2 Å. J. THEWLIS

541.183

7572. Specific adsorption isotherms of thiocyanate and hydrogen ions at the free surface of aqueous solutions. P. B. LORENZ. *J. Phys. Coll. Chem.*, 54, 685-90 (May, 1950).

For many inorganic electrolytes the surface tension of molar aqueous solutions is an additive function of the ion species. Assuming that the adsorption of potassium chloride at the free surface is largely electrostatic, it is compared with that of potassium thiocyanate to estimate the "specific adsorption isotherm" of thiocyanate ion. Measurements are reported of the surface tension of hydrochloric acid solutions from 10^{-3} M to 2 M, with a probable accuracy of about 0.01%. Below 0.3 M the surface tension exceeds that of pure water. The specific adsorption isotherm of hydrogen ion at the free surface is calculated and found to be nearly a straight line. A.

541.183 : 536.7

7573. Thermodynamics of adsorption. I. General considerations. D. H. EVERETT. *Trans. Faraday Soc.*, 46, 453-9 (June, 1950).

As a preliminary to a more detailed study of the thermodynamics of adsorption, the general methods of approach are discussed and it is concluded that a procedure closely akin to that employed in studying solutions is the most convenient both from the standpoint of analysis of experimental results and from that of theoretical interpretation. A.

541.183 : 539.16

7574. The investigation of surface processes with radioactive substances. H. FRAUENFELDER. *Helv. Phys. Acta*, 23 (No. 4) 347-80 (1950) In German.

New methods for measuring desorption probabilities, sticking coefficients and surface diffusion coefficients by means of radioactive substances are described. Recoil atoms from K capture are recorded; this allows the measurement of the adsorption of thin gas layers at low pressures and of extremely small diffusion coefficients. Experimental results are given and compared to former investigations with other methods. Applications to nuclear physics are the rapid separation of radioactive elements and the preparation of very thin sources. A.

541.183.57 : 536.7

7575. Statistical mechanics of adsorption. X. Thermodynamics of adsorption on an elastic adsorbent. T. L. HILL. *J. Chem. Phys.*, 18, 791-6 (June, 1950).

Thermodynamic equations are derived which should

be useful in the analysis of experimental data and theoretical models referring to the adsorption of a one-component gas on an elastic adsorbent. This problem is closely related to the thermodynamics of adsorption of a solute from a liquid solution on to an elastic adsorbent immersed in the solution (e.g. a myosin thread). A.

CHEMICAL STRUCTURE 541.4/6

541.57

7576. Term values in hybrid states. W. MOFFITT. *Proc. Roy. Soc., A*, **202**, 534-47 (Aug. 22, 1950).

In this paper a number of calculations are undertaken, which are considered necessary to a proper understanding of the factors governing orbital hybridization. A convenient classification of the different types of hybridization which arise for elements of the first short period is introduced. A general method is then developed for the calculation of the term values of the hybrid valence states associated with such atoms. This method is followed numerically for C, N and O, which are particularly interesting in chemistry. A.

541.57

7577. Aspects of hybridization. W. MOFFITT. *Proc. Roy. Soc. A*, **202**, 548-64 (Aug. 22, 1950).

It has been shown that the pairing theory of orbital hybridization accounts satisfactorily for the variations which are observed in the properties of C-H bonds. Since heteropolar effects are in the opposite directions to the effects described, it is concluded that hybridization influences the properties of predominantly covalent bonds to a greater extent than do differences in electronegativity. The extent of second-order hybridization in the molecules CH, NH and OH has been dealt with in the light of this analysis. The consequences of the electronegativity concept have been examined on the basis of a generalized atomic orbital approximation. In particular, variations of the electronegativity of the C, N and O atoms in different states of hybridization have been analysed. The idea of "lone" electrons has been formalized and the results of this definition have been discussed. Finally, the effects of orbital hybridization on the dipole moments and nuclear quadrupole coupling constants of molecules have been considered. A.

541.57 : 539.132

The molecular orbital theory of chemical valency. III. Properties of molecular orbitals. IV. The significance of equivalent orbitals. See Abstr. 7414-15

541.65

7578. Studies on the dependence of optical activity on chemical constitution. B. K. SINGH AND N. S. KAPUR. *Proc. Indian Acad. Sci., A*, **30**, 237-50 (Nov., 1949).

The rotatory dispersion of stereoisomeric salts of *o*-, *m*- and *p*-anisidine and *o*- and *p*-amino-phenols with camphor- β -sulphonic acid (*d*- and *l*-) is found

in different solvents to obey Drude's one-term equation, $[a] = k_0/(\lambda^2 - \lambda_0^2)$; it is, therefore, "simple". The *d*- and *l*-forms of these compounds possess identical rotatory power and thus support Pasteur's law of molecular dissymmetry. The sequence of rotatory power in different solvents is in the reverse order of their dielectric constants with minor variations. The racemic forms of the salts are found to be true *dl*-compounds. The influence of hydroxy and methoxy groups on the rotatory power and also the effect of position isomerism on rotatory power are discussed.

541.65 : 535.5

7579. Optical activity: its study, terminology and uses. M. P. BALFE. *Sci. Progr.*, **38**, 459-74 (Jul. 1950).

A survey, including fundamental definitions, of the application of optical activity to the elucidation of molecular structure and to the study of chemical equilibria and reactions. Bibl. 50 refs.

541.65 : 535.66 : 539.1

Excited electronic levels in conjugated molecules. IV. Symmetrical cyanine dyes. See Abstr. 7418

541.68 : 534.4

7580. On the structural absorption of ultrasonic waves in ethyl alcohol. D. SETTE. Letter in *Phys. Rev.* **78**, 476 (May 15, 1950).

CHEMICAL ANALYSIS 543/545

545.7 : 538.21

7581. New method for determining paramagnetic gases. K. F. LUFT. *C.R. Acad. Sci., Paris*, **230**, 1460 (April 17, 1950) In French.

A direct method of high sensitivity and ease of measurement is described. The method is likely to permit of following relatively rapid changes in concentration during metabolic processes.

W. R. ANG

545.71 : 535.21

7582. Photo-electric apparatus for the quantitative analysis of coloured gases. F. BERTEIN, C. CHERRIER, L. VEROT AND R. WAGNER. *C.R. Acad. Sci., Paris*, **230**, 1866-7 (May 22, 1950) In French.

An apparatus is described consisting of a glass by-pass tube mounted on the main gas conduit, incandescent bulb at one end of the tube and a photo-electric cell at the other end, the variations of the photo-electric current during the gas flow being amplified so as to operate an alarm relay. The apparatus has been adapted for (a) the determination and automatic recording of the content of Cl₂, NO₂ in a gaseous mixture, (b) the determination of the humidity of a gas, and (c) the signalling of quantity of one of the above gases, exceeding a previously fixed figure, having passed through the conduit, with an immediate stopping of the gas circulation.

F. LACHM

CRYSTALLOGRAPHY 548

548.0 : 535.323

The indices of refraction of some halide salts. H. HARTING. *S.B. Dtsch. Akad. Wiss. Math-Nat. Kl. (No. 4)* 25 pp. (1948) In German. Five selected experimental values of the index of refraction are fitted by equations of the form $n^{-2} = x\lambda^2 + y\lambda^{-2} + z\lambda^{-4} + v\lambda^{-6}$, where $x \dots v$ are adjustable constants. The agreement with intercalated experimental values is within a few parts in 100. The equations are used to calculate tables giving five decimal places at 10 $m\mu$ intervals from 1120 to 90 $m\mu$, and 2 $m\mu$ intervals from 400 to 240 $m\mu$, for NaF, LiF, CaF₂, NaCl, KCl, KBr, KI.

A. J. C. WILSON

548.0 : 535.6

4. Stability of color centers in alkali halides. MASLER, P. PRINGSHEIM AND P. YUSTER. *J. Chem. Phys.*, 18, 887-91 (June, 1950).

Colour centres have been formed in alkali halide crystals by exposing them to X-rays, electron bombardment, and pile irradiation, and their stability with respect to temperature and light bleaching has been investigated. In general such crystals contain centres of non-uniform stability. The lower the temperature at which the colour centres have been produced, the more unstable they are on the average. In the absorption spectra taken at low temperature of crystals irradiated at low temperature new bands appear on the short wavelength side of the *F*-band which are never observed in crystals irradiated at room temperature and which, on warming the crystal to room temperature, vanish together with a part of the centres. It is suggested that the instability of some of the colour centres formed at low temperature is connected with the presence of these new absorption bands.

A.

548.0 : 539.32

The elastic constants of sodium tartrate and Rochelle salt. See Abstr. 7537

548.0 : 539.375

25. Investigation of the critical shear stress for single crystals of metallic solid solutions. I. J. O. ANDERSON, B. LINDELL AND C. H. STADE. *Ark. Fys.*, 2, 109-111, 89-97 (1950).

Single crystals have been made from melts of Cu and dilute Cu alloys. Experimental arrangements have been developed for the determination of the critical shear stress of the alloys, using an electric method in which stress was measured by means of a strain gauge fastened to the crystal. The crystallographic orientation of the sample rods was determined by X-rays. Preliminary results show that the critical shear stress increases strongly with the concentration of solute elements. For solutions of Mn in Cu the increase in shear stress per atomic percent is much greater than for Sn in Cu.

A.

548.0 : 539.434

26. Surface effects in the creep of cadmium single crystals. J. W. MENTER AND E. O. HALL. Letter in *Nature, Lond.*, 165, 611-12 (April 15, 1950).

Confirms the observations of Andrade and Randall

[Abstr. 5102 (1949)]. Microscopic examination of the surface after extension in CdNO₃ reveals a crystalline dendritic growth. This is confirmed by potential measurements using the crystal as an electrode. With CdNO₃ as electrolyte there is a potential change during the initial creep ~ 100 times greater than that with CdCl₂ as electrolyte. Electron diffraction patterns indicate the layer to be Cd(OH)₂. In the case of crystals with an oxide surface film, it is suggested that slip cannot take place unless the film is (a) fractured by raising the local stress in the glide plane, or (b) opened by an ionic solution and the formation of the electrical double layer. After immersion in CdCl₂ solution the oxide film had broken up, allowing further plastic glide. In CdNO₃, this occurs initially, but cracks are subsequently closed by a film of hydroxide and glide is impeded.

A. J. KENNEDY

548.0 : 541.14

7587. Photochemical observations on KCl crystals. S. PETROFF. *Z. Phys.*, 127 (No. 4) 443-54 (1950) In German.

Crystals were exposed to K vapour and irradiated at wavelengths near the *f*-centre absorption band. Six new absorptions were observed on the long wavelength side of the *F*-band with intensities depending on the temperature and duration of exposure. The results are explained by assuming that different species of colour centres are formed photochemically. H. Pick and R. W. Pohl review related observations and explain the circumstances of publication.

J. R. MADDIX

548.1

7588. The number of homology classes of crystals. V. I. MIKHEEV. *Dokl. Akad. Nauk, SSSR*, 71 (No. 4) 667-70 (1950) In Russian.

Homology, of which symmetry is a special case, has been neglected because of the success of symmetry in treating crystal form. The basic definitions and theorems are stated and the elements of homology are tabulated for comparison with symmetry elements. If each of the 32 classes of symmetry suffers displacement or extension obliquely, $\parallel$, or $\perp$ to its elements of symmetry then the classes of homology can be obtained for each crystal system. There prove to be, triclinic 49, monoclinic 56, orthorhombic 18, tetragonal 10, trigonal 10, hexagonal 7 and cubic 5—in all 155 classes. As 123 correspond to the lower symmetry systems in which about 76% of natural substances occur homology may make possible a finer classification than hitherto.

A. L. MACKAY

548.24

7589. Mechanical twinning of quartz. A. V. STEPANOV. *J. Exp. Theor. Phys., USSR*, 20, 438-41 (May, 1950) In Russian.

The possibility of the existence of a close relation between the elastic properties and the twinning phenomenon of quartz crystals is considered under the angle of view of previous papers of the author [Abstr. 4017 (1948), 1227 (1949)]. The discussion is carried through for the 4 twinning laws hitherto established, viz. the Dauphiné, Brazil, 3rd (Leidolt's)

law and the Japanese law. The elastic properties of the β -quartz are known and may be represented schematically by a hexagonal prism consisting of sectors of alternating hardness. It is found that Dauphiné and Japanese twins are very likely to be formed under mechanical stresses, whereas the question regarding the possibility of crystals following the other two laws cannot at present be resolved.

B. F. KRAUS

548.51 : 532.78

7590. The rate of growth of a nucleus of a new phase on isothermal decomposition of a solid solution. B. YA. LYUBOV. *Dokl. Akad. Nauk, SSSR*, **72** (No. 2) 273-5 (1950) *In Russian*.

See Abstr. 3519 (1948). Two processes are necessary for the growth from a supercooled solid solution of a nucleus of a new phase differing in composition and structure from the solvent: (a) rebuilding of the lattice of the solvent, and (b) separation of the solute at the interface. In the early stages, near the critical size (b) is the slower and controlling factor, but when the nucleus is big the rate of growth is completely determined by (a). Expressions for the rate of growth are derived and the maximum rate occurring when the rates of (a) and (b) are equal is calculated. The effect of alloying on the stability of austenite is cited as experimental support for the theory. A. L. MACKAY

548.526

7591. Thickening of sodium chloride crystallization layers by specific adsorption of foreign ions. A. H. BOOTH. Letter in *Nature, Lond.*, **165**, 968-9 (June 17, 1950).

548.535 : 539.215

7592. Dislocation models of crystal grain boundaries. W. T. READ AND W. SHOCKLEY. *Phys. Rev.*, **78**, 275-89 (May 1, 1950).

The energies and motions of grain boundaries between two crystallites are investigated theoretically using the dislocation model of grain boundaries. Quantitative predictions made for simple boundaries for cases in which the plane of the boundary contains the axis of relative rotation of the grains appear to agree with available experimental data. The quantitative expression for energy per unit area for small angles is approximately $[Ga/4\pi(1-\sigma)]\theta[A-\ln\theta]$ where G is the rigidity modulus, a the lattice constant, σ Poisson's ratio, θ the relative rotation and A approximately 0.23. Grain boundaries of the form considered may permit intercrystalline slip and may act as stress raisers for the generation of dislocations.

A.

548.55 : 538.24

Domain wall movement in a single crystal. See Abstr. 7367

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

7593. Optical proof of the Schottky defect in silver bromide. O. STASIW. *Z. Phys.*, **127** (No. 5) 522-32 (1950) *In German*.

Optical data afforded by mixed crystals of AgBr

and Ag₂S are explained on the co-existence of 2 types of defect, viz. the Frenkel, due to sulphide ions, and the Schottky [*Z. Electrochem.*, **45**, 33-68 (Jan., 1939)] which was derived from thermodynamic-statistical theory.

H. H. HODGSON

544

7594. On the problem of order in solid solution. I. RUNGE. *Ann. Phys., Lpz.*, **7** (No. 3-4) 129-7 (1950) *In German*.

The idea of van der Waerden [Abstr. 769 (1944)] that "wrong" portions of an ordered plane net form comparatively small closed polygons in the "right" portion is developed, particularly by consideration of the alterations which interchange neighbouring atoms produce in the forms of polygons with perimeters of 4 to 10 interatomic distances. In the equilibrium state the rate at which, e.g., squares of perimeter 4 are produced from various polygons of perimeter 8 and 10, is equal to the rate at which they disappear. Eleven such balance equations are set up from which solutions for the number of polygons of various types are found in series of powers of the Boltzmann factor x . These differ from van der Waerden's series from x^8 on, but for the range $x(\leq \frac{1}{2})$ for which the latter are valid the corresponding energy differences are negligible. The differences are not due to neglect of polygons with perimeters greater than 10. The possibility of existence of boundaries extending right across the crystal and of an extension of the calculation to 3 dimensions is discussed.

A. J. C. WILSON

544

7595. Order-disorder transformations. B. KOCK. *Ann. Phys., Lpz.*, **7** (No. 1-2) 18-32 (1950) *In German*.

The properties of finite lattices containing small numbers of different atoms are discussed by enumerating the configurations directly. The shape of the experimental curve of C_v against temperature is reproduced.

J. R. MADEN

544

7596. Structural deviations in the surfaces of ionic crystals. III. K. MOLIÈRE. *Z. Phys.*, **127** (No. 1) 168-77 (1950) *In German*.

The "polarization sub-structures" described in previous papers [Abstr. 3520-1 (1948)], which occur in the surfaces of ionic crystals, are regarded as obtained by homogeneous deformation of the normal structure. Consideration is given to the most probable types of homogeneous deformation for particular types of crystal face, having regard to the symmetry and energy.

J. THEW

544

7597. Structural deviations in the surfaces of ionic crystals. IV. K. MOLIÈRE, W. RATHJE AND I. STRANSKI. *Z. Phys.*, **127** (No. 3) 178-86 (1950) *In German*.

The discussion of the formation of sub-structures in the surfaces of ionic crystals [see previous abstract] is extended to include consideration of the edges. The kind and degree of structural deviation are discussed and questions of crystal strength and habit considered.

J. THEW

548.7: 530.162
 598. A note on the eigenvalue problem in crystal statistics. Y. NAMBU. *Progr. Theor. Phys.*, **5**, 1-13 (Jan.-Feb., 1950).

Onsager's problem is formulated in terms of the operators of second quantization. A Fourier expansion permits the derivation of known results for the quadratic Ising lattice, a honeycomb and the Kramers-Wannier screw-constructed lattices. J. R. MADDOX

548.7: 530.162
 599. Statistical theory of superlattices of the type AB in a quadratic and a simple cubic lattice. Y.-C. HSU. *Chin. J. Phys.*, **7**, 207-29 (April, 1949).

Wang's generalized theory of superlattices [Abstr. 686 (1945)] is applied to binary alloys. Nearest-neighbour interactions for 2 shells surrounding each atom are considered, and the numbers of A and B atoms are not required to be equal. In the special case of equal numbers, results close to those of Bethe's and approximation are obtained; for the simple cubic lattice the discontinuity in C_p at the critical temperature is $2.07 k$ per atom instead of $1.94 k$.

A. J. C. WILSON

548.7: 535.343.4-14: 539.152
 Angular dependence of crystalline nuclear resonance absorption. See Abstr. 7425

548.7: 535.375.5
 Molecular scattering of Iceland spar. See Abstr. 7159

548.7: 535.375.5
 Second order Raman spectrum of the potassium crystal. See Abstr. 7160

548.7: 537.226
 7600. On the lattice polarization induced by electronic motion. M. NOGAMI. *Progr. Theor. Phys.*, **5**, 56-64 (Jan.-Feb., 1950).

The equivalent potential of an electron in a perfect lattice is calculated using perturbation theory, averaging over unit cells. It is a self-interaction term similar to that derived by Mott and Gurney [*Proc. Phys. Soc.*, **49**, 3-154 (Aug., 1937)] to describe the self-trapping of an electron in a lattice. The effect of the polarization on transition probabilities is also calculated. It cannot always be accounted for by a dielectric constant. G. J. KYNCH

548.7: 537.226
 7601. Theory of the polarization of ionic crystals. V. I. ODELEVSKIĬ. *J. Tech. Phys., USSR*, **20** (No. 2) 129-36 (1950) In Russian.

Born's theory of polarization of ionic crystals is built on 3 basic characteristics, the static d.c., the resonance frequency of the ionic polarization oscillations and the volume compression coefficient, from which the eigenfrequency of the crystal is calculated. The derivation is based on the conception of different fields in the static case and for rapid oscillations; in the first case Clausius-Mosotti's formula is used. The insufficiency of this conception, as well as of Lorentz's theory, was proved by investigations of a large series of alkali halide crystals, in the course of which Pauling-Mott's idea of the overlap of the

electron clouds was also checked and replaced by a scheme of the ionic crystal, considering the deformations of the electron clouds by interaction between themselves. The latter was obtained by calculating the "counter-moments" and the experimental verification showed satisfactory agreement. B. F. KRAUS

548.7: 539.11
 Compressibilities, force constants, and interatomic distances of the elements in the solid state. See Abstr. 7402

548.7: 539.152.2
 Proton nuclear magnetic resonance studies in KH_2PO_4 , KH_2AsO_4 , $NH_4H_2PO_4$ and $NH_4H_2AsO_4$. See Abstr. 7444

548.7: 539.37
 The theory of displacements in one-dimensional atomic lattices. See Abstr. 7541

548.73
 7602. Two-dimensional diffraction effects in X-ray photographs of polycrystalline specimens of aged Ag-Cu alloys. A. I. PASHILOV. *Dokl. Akad. Nauk, SSSR*, **72** (No. 2) 281-3 (1950) In Russian.

Alloys with 6.5 wt % Cu were studied with unfiltered Cu radiation. Aged alloys showed diffuse spots, due to characteristic radiation, and long thin streaks, due to continuous radiation. The effects are compared with those observed by Preston and Guinier. A. J. C. WILSON

548.732
 7603. The photography of atoms in crystals. M. J. BUEGER. *Proc. Nat. Acad. Sci., Wash.*, **36**, 330-5 (May, 1950).

The theory of a microscope as 2 stages of diffraction is developed, and it is shown that if the 2 stages involve radiations of different wavelength, as in the "X-ray microscope" [W. L. Bragg, *Nature, Lond.*, **143**, 678 (1939)], the magnification is $D_2\lambda_2/D_1\lambda_1$, where D_1 , D_2 are the effective object and image distances, and λ_1 , λ_2 are the object and image wavelengths. The theory is illustrated by the production of a "micro-photograph" of the structure of marcasite, the necessary phase shifts being re-introduced into the first diffraction pattern by thin mica plates. Abstr. 1013 (1941). A. J. C. WILSON

548.733
 7604. Improved double-crystal spectrometer for small angle scattering measurements. L. BROUSSARD. Note in *Rev. Sci. Instrum.*, **21**, 399-400 (April, 1950).

548.733
 7605. Combination two-circle goniometer and X-ray spectrometer. M. L. BARON AND A. DEBRETTEVILLE, JR. *Rev. Sci. Instrum.*, **21**, 458-61 (May, 1950).

A combination instrument consisting of a 2-circle goniometer and X-ray spectrometer suitable for the study of crystals was designed and fabricated. A crystal can be oriented optically by using the instrument as a goniometer. X-ray techniques can then be used to study the crystal by replacing the collimator and telescope with an X-ray slit system and a Geiger counter. Absolute intensity measurements can be

made by fixing the Geiger counter at twice the Bragg angle (θ) and rotating the crystal at 8° per hour from $\theta - \Delta\theta$ to $\theta + \Delta\theta$. Back reflection angles of up to 160° are obtainable. The result of a test on synthetic halite (400) reflection, gave a structure factor 12.7 compared with Renniger's value of 12.67. No absorption corrections are required with this technique of measuring intensities. A.

548.733

7606. A high-temperature X-ray diffraction camera. H. J. GOLDSCHMIDT AND J. CUNNINGHAM. *J. Sci. Instrum.*, 27, 177-82 (July, 1950).

A versatile 19 cm X-ray diffraction camera, designed to operate up to at least 1400°C is described. The specimen can be in either a vacuum or a gaseous atmosphere, the attainment of as high a degree of vacuum as possible being a major consideration in design. The camera is suitable for both fibre (powder) or small block specimens. The furnace chamber is heated by Pt-Rh resistance wire, held by alumina within hemispherical platinum shells, the whole being surrounded by a reflector. The temperature is measured by a movable thermocouple and the pressure by an ionization gauge. Two cassettes are located outside the vacuum chamber, which are interchangeable for studies of continuous reactions, and they are designed to record Bragg reflections over a wide angular range (up to 86°). Initial performance trials are described. A.

548.733 : 621.396.611.21

7607. The manufacture of quartz oscillator-plates. II. Control of the cutting angles by X-ray diffraction. W. PARRISH. *Philips Tech. Rev.*, 11, 351-60 (June, 1950).

After a discussion of the tolerances in the manufacture of quartz oscillator-plates, the X-ray diffraction apparatus is described constructed to enable a rapid and accurate check of the crystallographic angles of test cuts. A G.M. counter tube is used in this apparatus to detect the reflected X-ray beam. After placing the counter tube in the position 2Θ (Θ = Bragg angle) on a goniometer scale, the holder in which the test piece, test wafer or blank to be examined is clamped is turned until reflection occurs. The reflecting lattice plane is then oriented according to the angle Θ on the goniometer scale and from this the angles between this lattice plane and the reference surface of the crystal holder (cutting plane of the test cut) can be derived. The execution of the measurements, in particular the choice of a suitable lattice plane of reference is explained by means of several examples: checking the YZ-cut in making an X-block and checking AT and BT cuts. A.

548.734

7608. Fine-structure photographs in a very short time by the X-ray flash tube. R. SCHALL. *Z. angew. Phys.*, 2 (No. 2) 83-8 (1950) In German.

A commercial X-ray flash tube was modified to take a Cu target and used for obtaining X-ray diffraction pictures. Length of exposure time limited the specimens to single crystals, which were examined by knife-edge, wide-angle or focusing methods. The 1st

and 3rd methods needed one flash only; the 2nd about 10 or 15. Each flash lasts for less than $0.5 \mu\text{sec}$ and corresponds to up to 10^8 W at 50 to 70 kV. The method was used to investigate the lattice distortion of mica, caused by the explosive evaporation of an Al foil to which the mica is stuck.

J. THEWILL

548.734.1

7609. Analysis of intensities obtainable using pinhole and slit collimators in X-ray powder diffraction techniques. L. ALEXANDER. *J. Appl. Phys.*, 21, 779-82 (Aug., 1950).

Other factors being equal, the integrated intensity of a powder diffraction reflection is a function of the geometry of the source, collimator, and sample. By means of a geometrical and algebraic analysis one can predict the relative intensities to be expected with pinhole or slit collimators of different dimensions. Important gains in intensity can be obtained by replacing pinholes with slits, and the advantage is about the same if the X-ray focal spot is viewed either longitudinally or laterally through slits of sufficient length. These results confirm experimental results reported by other investigators and also re-emphasize the potential value of the "side" windows of X-ray tubes, which are commonly neglected. A.

548.734.2

7610. Double crystal and slit methods in small angle X-ray scattering. H. N. RITLAND, P. KAESBERG AND W. W. BEEMAN. *J. Appl. Phys.*, 21, 838-41 (Aug., 1950).

An angular resolution of about 10 seconds of arc may be obtained with a double calcite crystal spectrometer for Cu $K\alpha$ radiation. However, the shape of the rocking curve at large angles is such as to make the detection of radiation from weakly scattering materials difficult. Of the order of 10^6 counts per second are detected with a stationary, water-cooled Cu target and parallel crystals. Wing intensities, even at large angles, do not fall much below 10^2 counts per second. Wing heights may be considerably reduced by the addition of a third calcite crystal. With this modification the crystal spectrometer is a useful instrument for most scattering experiments in which extremely high resolution is desired. It is inferior to a slit system and Geiger counter arrangement where poorer resolution may be tolerated but high sensitivity is required. A slit instrument with an angular resolution of 4 or 5 minutes of arc provides an effective incident flux of more than 10^6 counts per second while wing intensities may be as low as 1 count per second. A.

548.733

7611. Contribution to the study of X-ray microscopy. III. Representation of crystalline structures by plane nets. Diffraction of light on reciprocal nets. L. BRÚ AND M. CUBERO. *An. Real Soc. Esp. Fis. y Quím.* 46A, 5-24 (Jan.-Feb., 1950) In Spanish.

In the application of the "fly's eye" method for evaluating the X-ray diffraction pattern of a triaxial structure, one of the difficulties is that the optical diffraction pattern of a circular aperture is not a close

proximation to the X-ray scattering factor of an atom. This difficulty could be overcome by the use of apertures with a radial variation in transparency, but it is easier to use apertures of varying size. They are largest in the centre of the pattern representing several repeat units of the crystal, and decrease in size with distance from the centre in a way that can be calculated from the atomic scattering factor to be anticipated. Detailed calculations are given for Cu and BaCl_2 , and photographs showing the improvement in the diffraction patterns are reproduced. The reverse process, synthesizing the structure from a representation of the reciprocal net, is also performed.

A. J. C. WILSON

548.735.4

7612. The crystallographic symmetries determinable by X-ray diffraction. M. J. BUEGER. *Proc. Nat. Acad. Sci., Wash.*, **36**, 324-9 (May, 1950).

Purely X-ray methods for the determination of space groups are discussed, with particular reference to those of vector sets [Abstr. 3517 (1950)] and intensity statistics [Abstr. 2781 (1950)]. A. J. C. WILSON

548.735.46

7613. The determination of crystal structures from the Patterson diagram. J. CLASTRE AND R. GAY. *C.R. Acad. Sci., Paris*, **230**, 1876-7 (May 22, 1950). The determination of crystalline structures using the Patterson translation. J. GARRIDO. *Ibid.*, **230**, 1878-9 (May 22, 1950). Remarks on the above papers. C. MAUGUIN. *Ibid.*, **230**, 1879-80 (May 22, 1950). *In French*.

If 2 identical vector sets (ideal Patterson diagrams) are translated so that the origin of the first coincides with a non-origin peak of the second, among the other coincident peaks will be N corresponding to the actual point set (atomic positions), when N is the number of points (atoms). Another translation will suffice to distinguish the coincidences which give the point set, so that a resolved Patterson can be reduced to the crystal structure in 2 operations (in certain favourable cases 1), not $N-1$ as required by Buerger's method [Abstr. 3517 (1950)]. Methods are discussed for performing the translations graphically or numerically, and for overcoming practical difficulties.

A. J. C. WILSON

548.736

7614. The chemistry of the transition elements. W. KLEMM. *Naturwissenschaften*, **37**, 150-6 (April, 1950) *In German*.

A survey is given of the transition elements from Ti to Cu with respect to their halides, oxides, sulphides, selenides and tellurides. The discussion mainly involves molecular volumes and lattice structures, but the anomalies of Mn compounds and also the magnetic behaviour of TiCl_3 receive special attention.

H. H. HODGSON

548.736.5

7615. Tensimetric and X-ray investigations on magnesium carbonate trihydrate and its dehydration products. A. LANNUNG AND A. T. JENSEN. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **25** (No. 12) 36 pp. (1949).

548.737

7616. X-ray patterns of soaps. A. J. STOSICK. Letter in *J. Chem. Phys.*, **18**, 757 (May, 1950).

548.74

7617. Determination of the position of hydrogen in the crystal lattice of paraffin. B. K. VAJNSHTEIN AND Z. G. PINSKER. *Dokl. Akad. Nauk, SSSR*, **72** (No. 1) 53-6 (1950) *In Russian*.

The authors' methods of electron diffraction and Fourier synthesis [Abstr. 2794-5 (1950)] are used to determine the potential distribution in solid paraffin. The H atoms, found only with difficulty by X-ray diffraction [Abstr. 4007 (1949)], are clearly resolved in both 2-dimensional projections and 3-dimensional sections. Space group $Pnam$, $a = 4.96 \pm 1$, $b = 7.41 \pm 2$, c (repeat distance along "backbone") $= 2.54 \pm 1 \text{ \AA}$, C at (0.040, 0.057, $\frac{1}{2}$), H_1 at (0.198, 0.042, $\frac{1}{2}$), H_2 at (0.014, 0.029, $\frac{1}{2}$). These parameters give for the intramolecular distances and angles C-C 1.52, C-H 1.17, H-H 1.83 $\text{\AA}$, C-C-C 110°, H-C-H 105°.

A. J. C. WILSON

548.74

7618. An exception to Friedel's law in electron diffraction. S. MIYAKE AND R. UYEDA. Note in *Acta Cryst.*, **3** (No. 4) 314 (July, 1950).

Electron diffraction photographs obtained from single crystals of ZnS show asymmetry about the (001) plane, this asymmetry being related to the polar axes of the crystal. No explanation of the phenomenon is offered, but it is stated that K. Kohra has deduced one from the dynamical theory of diffraction.

J. THEWLIS

548.74

7619. The shape transform in electron diffraction by small crystals. A. L. G. REES AND J. A. SPINK. Note in *Acta Cryst.*, **3** (No. 4) 316-17 (July, 1950).

The shapes of the reciprocal lattice spots in ZnO are investigated by the use of a high-resolution electron-diffraction camera, and the presence of subsidiary maxima, as calculated by Patterson, is confirmed. It is suggested that the method might be applied to the study of the size and shape of molecularly dispersed protein molecules.

J. THEWLIS

548.75 : 535.343.2

Change of structure of crystals followed spectroscopically. See Abstr. 7128

GEOPHYSICS 55

550.34
7620. Microseisms. A. N. TANDON. *Indian J. Phys.*, **24**, 80-90 (Feb., 1950).

The type, nature and origin of different microseismic phenomena have been summarized. The relation existing between microseisms and disturbed weather has been discussed and the latest work in America on the tracking of storms when they are far out at sea, with the help of microseisms, has been described. A.

550.342 : 551.465
7621. Identification of microseismic activity with sea waves. J. DARBYSHIRE. *Proc. Roy. Soc. A.*, **202**, 439-48 (Aug. 7, 1950).

Three series of simultaneous wave and microseism records are examined. They give a clear indication that bands of microseismic waves from different sources can be distinguished by submitting seismograph records to frequency analysis. The agreement between the results of analysis and the theoretical expectation from the prevailing meteorological conditions appears to justify the assumption that microseismic waves of different periods travel independently. Under the simple meteorological conditions that have been studied, each band of microseismic activity can be identified with a band of sea waves of twice its period. The existence of this two-to-one ratio between the period of waves and microseisms affords some confirmation of the theory that microseisms are produced in a region of interference between similar wave trains travelling in opposite directions either near the coast or in deep water. A.

550.345 : 551.465
7622. The Airy phase of shallow-focus submarine earthquakes. F. PRESS, M. EWING AND I. TOLSTOY. *Bull. Seism. Soc. Amer.*, **40**, 111-48 (April, 1950).

An extension of the theoretical work of Lamb and Pekeris shows that a prominent phase (Airy phase) consisting of a group of waves of period 9-11 sec, travelling across the ocean with a velocity of approximately 0.7 of the speed of sound in water, should be present on the seismograms of shallow-focus submarine earthquakes. This arrival corresponds to normal mode propagation at a stationary value of group velocity through the acoustic system consisting of the ocean and the rigid ocean bottom. A phase fitting this description has been observed at Bermuda and at Huanayo. The study of the Airy phase of a sufficient number of sea quakes would provide information concerning the nature of the ocean bottom, since the latter affects both the periods and velocities of the Airy phase. A.

550.362
7623. Determination of thermal constants by probes. I. I. TSUKKERMANN. *J. Tech. Phys. USSR*, **20** (No. 3) 353-62 (1950) *In Russian*.

The knowledge of the coefficient of thermal conductivity, specific heat and coefficient of temperature conductivity is important for many problems of geophysics and agrophysics. The most successful method is the sinking of heat sources of known output, and determination of the temperature field

produced by them theoretically and experimentally. The paper gives the theory of the field of such artificial sources of plane, cylindrical and spherical shape. The expansions in the case of the cylindrical probe are in terms of Macdonald functions. B. F. KRAUS

550.384
7624. Sudden commencements in geomagnetism. R. A. WATSON AND D. H. MCINTOSH. Letter in *Nature, Lond.*, **165**, 1018 (June 24, 1950).

550.387
7625. Rapid variations of telluric currents. Y. BEAUFILS. *C.R. Acad. Sci., Paris*, **230**, 2108-10 (June 12, 1950) *In French*.

The author examines by harmonic analysis the correlation between the traces of telluric currents at stations widely separated and also the correlation between telluric currents (at Gabon) and geomagnetic variations (at Chambon-la-Forêt). The latter correlation appears to be particularly close when the horizontal force of the magnetic field and the EW component of the telluric currents are considered. The latter component, however, appears to be in-quadrature with the vertical component of the field for oscillations of 25 sec at Saint-Germain-du-Bois and those of 30 sec recorded in Morocco. Considering the normal oscillations of telluric currents, their origin is uncertain, but may be related to the rapid variations of ionospheric conditions.

V. C. A. FERRARO
551.24
7626. The formation of continents and geodynamic forces. M. MATSCHINSKI. *C.R. Acad. Sci., Paris*, **230**, 1882-4 (May 22, 1950) *In French*.

It is suggested that the solidification of the Earth's crust produced a slight heating up of the Earth as a whole and that the consequent expansion of the core was sufficient to cause fracture in the crust. These cracks continued to grow slowly and have gradually led to the formation of the continents. B. C. BROWNE

551.46 : 532.593
7627. Surf beats: sea waves of 1 to 5 min period. M. J. TUCKER. *Proc. Roy. Soc. A*, **202**, 565-73 (Aug. 22, 1950).

Long sea waves with periods of 2 to 3 min and a few inches in amplitude have been measured. It has been shown that they are due to the varying height of groups of waves breaking on the shore. The amplitude of the long waves is found to be approximately proportional to the amplitude of the ordinary waves and independent of their period. The mechanism by which they are produced is discussed. A.

ATMOSPHERE . METEOROLOGY 551.5

551.509.312
7628. A method of approximate calculation for air mass transfer. H. ERTEL. *S.B. Dtsch. Akad. Wiss. Berlin, Math.-nat. Kl. (No. 3)* 23 pp. (1948) *In German*.

For short period forecasting a system of equations

is first developed to calculate air mass displacement and thus find to a first approximation which air mass would reach a selected place at a given time. The solution of the system of equations results from a successive approximation procedure whose convergence conditions are ascertained. For practical purposes a simple graphical method can be applied.

R. S. READ

551.510.4

7629. Detection of carbon monoxide in the earth's atmosphere, at 3 580 m. M. MIGEOTTE AND L. NEVEN. Letter in *Physica*, **16**, 423-4 (April, 1950).

550.510.5

7630. The stratification of the atmosphere. I. H. FLOHN AND R. PENNDORF. *Bull. Amer. Met. Soc.*, **31**, 71-8 (March, 1950).

A suitable nomenclature for atmospheric strata as well as a clear definition of the boundaries is proposed. The necessity of such a new classification is stressed. The atmosphere is divided into an inner and an outer atmosphere; from the latter particles may escape. The inner atmosphere is divided into 3 spheres—troposphere, stratosphere and ionosphere—with each sphere in turn being subdivided into 3 or 4 layers. The new classification is based upon the thermal structure of the atmosphere. Boundaries of each layer are fixed by a sudden change of lapse rate. The bottom layer, the ground layer, the advection layer and the tropopause layer are subdivisions of the troposphere. The advantages gained by defining a separate tropopause layer as part of the troposphere are discussed in detail. Its upper boundary is assumed to be situated at 12 km over temperate latitudes. The stratosphere, consisting of an isothermal layer, a warm layer and an upper mixing layer, extends from 12 to 80 km. The atmosphere between 80 and 800 km is occupied by the ionosphere, the subdivisions of which are the *E*-layer, the *F*-layer and the atomic layer. Above that height the exosphere exists.

A.

551.510.5

7631. The stratification of the atmosphere. II. H. FLOHN AND R. PENNDORF. *Bull. Amer. Met. Soc.*, **31**, 126-30 (April, 1950).

A factual summary of recent information concerning the physical characteristics of the terrestrial atmosphere, above the tropopause, grouped as in preceding Abstr. A bibliography of selected references to recent work (1936-1950) on atmospheric structure is included.

D. R. BARBER

551.510.535

7632. Travelling disturbances in the ionosphere. G. H. MUNRO. *Proc. Roy. Soc. A*, **202**, 208-23 (July 7, 1950).

Methods have been developed for the examination of the horizontal and vertical movements of short-period disturbances in the ionosphere. It has been found that quasi-periodic travelling disturbances with periods of from 10 to 60 min are of frequent occurrence in the *F* region by day. They appear as temporary variations in the vertical distribution of ionization which show a horizontal progression and a vertical progression downwards. The horizontal directions of

travel have a well-defined mean direction on most days. The mean direction shows a marked seasonal variation with a sudden change at each equinox. The horizontal rate of travel is usually between 5 and 10 km/min, and the rate of vertical progression downwards is approximately half the horizontal rate. The disturbances are considered to be variations of a compressional type in the atmosphere resulting in changes in the distribution of ionization.

A.

551.543.1 : 551.590.2

7633. Oscillations of the earth's atmosphere. M. V. WILKES. *Cambridge Monographs on Physics. Cambridge University Press* (1949) 74 pp., 23 figs., 9 tables.

A short textbook on the forced oscillations of the atmosphere caused by gravitation (tides) and solar radiation. Chapter I gives history of observation and theory of solar and lunar atmospheric tides at surface and lunar semidiurnal tide in ionosphere, including Chapman's statistical analyses. Chapter II sets out mathematical theory of oscillations in a rotating atmosphere, including derivation of Laplace's tidal equation, and discusses various solutions, especially the semidiurnal. In Chapter III the numerical evaluation of this equation is examined and it is shown that a forced oscillation of the atmosphere requires an upward flow of energy at a level just below that at which effects of absorption (damping) become operative. Chapter IV relates oscillations of the atmosphere to temperatures at great heights. The treatment is based on trapping of tidal energy in the atmosphere and the dependence of the resonance theory on the existence of barriers. It is shown that under certain conditions sharp resonance exists near 12 h. The results are discussed in Chapter V; the general features of both lunar and solar tides can now be explained but some difficulties remain.

METEOROLOGICAL ABSTRACTS

551.543.3

7634. Oscillations in the stratosphere and high troposphere. G. EMMONS, B. HAURWITZ AND A. F. SPILHAUS. *Bull. Amer. Met. Soc.*, **31**, 135-8 (April, 1950).

During several flights of constant-level balloons pressure oscillations with periods between about 4 and 10 minutes were recorded. Since these periodic height variations of the balloons cannot be attributed to the mechanism maintaining the level of the balloon they must be regarded as records of atmospheric oscillations. The lengths of the observed periods agree with those computed from the estimated lapse rates of temperature, if the inaccuracies in the determination of these lapse rates are taken into account.

A.

551.55

7635. Details of wind structure revealed by artificial nucleation of supercooled clouds. R. FRITH. Letter in *Nature, Lond.*, **165**, 899-900 (June 3, 1950).

551.573 : 551.554

7636. A note on three-dimensional turbulence and evaporation in the lower atmosphere. D. R. DAVIES. *Proc. Roy. Soc. A*, **202**, 96-103 (June 22, 1950).

In view of the practical significance in dynamical

meteorology of the problem of evaporation from areas of finite lateral extent, it is a matter of fundamental importance to test as fully as possible the applicability of the hypothetical 3-dimensional model of turbulence which was introduced by the author in 1947 [Abstr. 2348 (1947)]. The present paper describes how the 2-dimensional system developed by O. G. Sutton, K. L. Calder and E. L. Deacon [Abstr. 3578 (1950); 4561, 3609 (1949)] for flow over aerodynamically smooth and rough surfaces may be extended to 3-dimensional diffusion of vapour over an evaporating area. The agreement obtained between theory and experiment is good at points over the area. This agreement indicates that the assumed law, introduced by the author to give the variation of the coefficient of lateral diffusivity with height above the surface, may be used satisfactorily in evaporation problems as long as attention is confined to points not too far outside the boundaries of the area. The complicated mathematical relationship previously obtained for the vapour distribution vertically above the down-wind edge of a parabolic strip is reduced to a much simpler one. This serves to bring out explicitly the relationship between the effects of the 2- and 3-dimensional theoretical systems of turbulent transfer at points on the central axis of the area.

A.

551.573 : 551.554

7637. Three-dimensional turbulence and evaporation in the lower atmosphere. I. D. R. DAVIES. *Quart. J. Mech. Appl. Math.*, **3**, 51-63 (March, 1950).

The investigation is a first approach to the problem of turbulent diffusion from a finite rectangular lake. A formal solution in terms of Mathieu functions is obtained for the problem of vapour distribution above and down-wind of the lake on the basis of an assumed law of lateral diffusivity. The air-stream is assumed to be fully turbulent and directed parallel to the longitudinal length of the lake. The application of the formal solution to special cases awaits the complete tabulation of Mathieu functions.

A.

551.573 : 551.554

7638. Three-dimensional turbulence and evaporation in the lower atmosphere. II. D. R. DAVIES. *Quart. J. Mech. Appl. Math.*, **3**, 64-73 (March, 1950).

This paper gives a determination of a power law for the variation of the coefficient of lateral diffusivity with height above ground, and contains a discussion of the application of a previously used law to evaporation problems. The index in the power law is determined by comparison of theory with well-known results giving the variation of peak concentration (i.e. weight of suspended matter per unit volume) with distance down-wind from a continuous point source, such as a single static smoke generator, producing a cloud of air-borne particles of matter. The applications of this empirical law of diffusivity, and of one previously used, to evaporation problems are compared and discussed.

A.

551.576.11 : 532.69

7639. The growth of cloud droplets by coalescence. P. K. DAS. *Indian J. Met. Geophys.*, **1**, 137-44 (April, 1950).

An attempt is made to obtain an estimate of the

percentage of small droplets swept out of the path of a large drop. The method followed is along the lines of a similar treatment by Taylor and developed by Glauert for droplets approaching a cylinder and an aerofoil. Sets of trajectories are drawn for droplets approaching a sphere having the dimensions of a large cloud drop. Using these trajectories new values of the percentage catch have been computed in a number of cases.

551.53

7640. Experimental meteorology. V. J. SCHAEFER. *Z. angew. Math. Phys.*, **1**, 153-84 (May 15, 1950).

Survey article, mainly on precipitation processes and research on artificial rain production.

551.577 : 621.396.9

7641. Radar echoes from meteorological precipitation. J. E. N. HOOPER AND A. A. KIPPAX. *Proc. Instn Elec Engrs, Pt I*, **97**, 89-97 (May, 1950).

Experiments, using radar sets operating on wave lengths of 9.1, 3.2 and 1.25 cm, are described, the results of which confirm the theoretical dependence of radar echo power on drop-size distribution, pulse energy and wavelength. Measurements of the echo intensity of a "bright band," which appears with echoes from rain at a height a little below the freezing level, are reported, and an explanation of the phenomenon is offered. Some possible uses of observation of radar echoes from precipitation are mentioned briefly.

551.577.11 : 621.396.9 : 621.396.11

7642. The bright band—a phenomenon associated with radar echoes from falling rain. J. E. N. HOOPER AND A. A. KIPPAX. *Quart. J. Roy. Met. Soc.*, **76**, 125-32 (April, 1950).

Frontal rain when illuminated by radar transmission gives rise to echoes which exhibit a characteristic layer of greater intensity near to the freezing level. Observations which establish the height of this layer or "bright band," relative to that of the freezing level, are described. Measurements of the terminal velocities of snow flakes of known mass, a factor of importance in support of a possible explanation of the phenomenon, are also given.

551.578.11

7643. Experiments with silver iodide smokes in the natural atmosphere. B. VONNEGUT. *Bull. Amer. Met. Soc.*, **31**, 151-7 (May, 1950).

Preliminary experiments have been made on seeding natural supercooled clouds with AgI smokes. It is believed that in many cases positive effects were observed. In a majority of the experiments it is impossible to prove beyond doubt that the effects are the result of the seeding. However, certain of these experiments demonstrate conclusively that modification of natural clouds with AgI smokes can be achieved. Areas of supercooled ground fog several 100 ft in diameter have been changed to ice at a temperature of -5°C by small scale releases of AgI smoke from the ground. Similarly areas up to a mile in diameter have been filled with small ice crystals by releasing the smoke at -20°C when the

air is supersaturated with respect to ice. In 1948 a supercooled stratus cloud layer approximately 1 000 ft thick at a temperature of -10° was seeded from an aeroplane; about 6 sq miles of the supercooled cloud layer were transformed into ice crystals as the result of seeding with somewhat less than 1 oz of AgI. A.

551.578.11 : 536.24

A note on the thermal inertia of cloud particles. See Abstr. 7191

551.593.1

7644. Apparatus for recording fluctuations in the refractive index of the atmosphere at 3.2 centimeters wave-length. C. M. CRAIN. *Rev. Sci. Instrum.*, **21**, 456-7 (May, 1950).

The equipment is a modification of that previously used for measuring dielectric constants of gases [Abstr. 1014 (1949)]. The frequency of each of 2 microwave oscillators is controlled by the resonant frequency of its associated cavity resonator. One cavity is sealed off and the other modified by drilling holes in one end plate, through which air is pulled. A.

551.593.12 : 612.84 : 525.722

7645. The scintillation of stars. M. MINNAERT, H. F. H. JONES, K. HARRISON, G. C. VARLEY, M. A. ELLISON, G. S. BRINDLEY AND H. HARTRIDGE. *Nature, Lond.*, **165**, 663-8 (April 29, 1950).

Minnaert: Most of the effects which Hartridge [Abstr. 3584 (1950)] would expect to be observed on the basis of a physical explanation of the above effect are in fact observed: how would physiology explain the marked difference in scintillation between stars at high and low altitudes? The possibility of contributory physiological effects is admitted. Jones: Stars do not appear to scintillate when viewed in the tropics. Harrison draws attention to "jumping stars." Varley and Ellison describe the colour and brightness changes observed when field-glasses are moved rapidly to and fro so that the star point-image is drawn into a circle: the length of the coloured streaks depends on the rate of movement, hence a physiological basis seems unacceptable. Using a red filter and a neon-lamp, Varley finds that Sirius scintillates some 30 times per sec; Saturn does not scintillate under similar conditions. Brindley describes an experiment showing that 2 images of the same star scintillate nearly synchronously. Hartridge states in reply that purple, a colour observed by Ellison, would not be expected, and shows by 2 simple calculations that Ellison's and Brindley's results are each inconsistent with a physical explanation. An experiment is described in which a minute light source was viewed through an evacuated tube: even so the source was observed to scintillate.

R. A. WEALE

551.593.12 : 612.84 : 525.722

7646. The scintillation of stars. A. H. R. GOLDIE. Letter in *Nature, Lond.*, **165**, 1019 (June 24, 1950).

The suggestion is made that the phenomena of stellar scintillation [see Abstr. 2833, 3584 (1950)] may be directly associated with wave motions at the interface of two atmospheric currents, wavelength up to

10 miles, velocity up to 40 ft/sec, and amplitude 500 to 1 000 ft. The presence of such waves is confirmed by anemographic records from well-exposed sites, and from temperature-humidity records from horizontal aeroplane flights.

D. R. BARBER

551.593.7

7647. Arago's neutral point: A neglected tool in meteorological research. H. NEUBERGER. *Bull. Amer. Met. Soc.*, **31**, 119-25 (April, 1950).

The nature of Arago's neutral point of atmospheric polarization and its underlying physical principles are explained. Various criteria of atmospheric turbidity that can be derived from observations of this neutral point are discussed and their relative merits compared. Examples of the usefulness and potentialities of these criteria are cited. In particular, the influence of the size of the particles polluting the atmosphere and of meteorological factors on spectral observations of Arago's neutral point is shown. A selection of problems connected with the interpretation of measurements of Arago's point is presented. A.

551.593.9

7648. New information about the radiation of the night sky in the region 8 800-11,000 Å. V. I. KRASOVSKIĬ. *Dokl. Akad. Nauk, SSSR*, **70** (No. 6) 999-1000 (1950) In Russian.

New lines have been discovered in the radiation of the night sky (8 870, 9 391, 9 976, 10 217, 10 374 and 10 827 Å, the mean probable error being from ± 2 to ± 4 Å). Contrary to results reported by Stebbins, Whitford and Swings [Abstr. 833, 3137 (1945)] no considerable radiation has been found about 10 400-10 440 Å, while a distinct radiation has been found about 8 900 Å.

F. LACHMAN

551.593.9

7649. Theory of the spectral emission from the molecule OH in the night-sky spectrum. D. R. BATES AND M. NICOLET. *C.R. Acad. Sci., Paris*, **230**, 1943-5 (May 31, 1950) In French.

On the assumption of a primary photo-dissociation of H_2O at altitudes up to 70 km by solar radiation, a theory is developed to explain the observed characteristics of OH emission from the nocturnal sky. The emission originates from a transition zone at c. 80 km, where H_2O , HO_2 , OH and H co-exist in proportions determined by the height-concentrations of O and O_3 , and results from the 3 possible processes: (1) $H + O \rightarrow M \rightarrow OH$ (excited) + M; (2) $H + O \rightarrow OH$ (excited) + $h\nu$; (3) $H + O_3 \rightarrow OH$ (excited) + O_2 . Between 60 and 80 km reaction (3) will predominate and, for an emitting layer 10 km thick, at 80 km altitude, theory predicts an excitation level of 5×10^{10} quanta $cm^{-2} sec^{-1}$. This agrees well with observation.

D. R. BARBER

551.593.9 : 535.338.4-14

OH emission bands in the spectrum of the night sky. See Abstr. 7121

551.593.9 : 621.391.63

7650. Comparative investigations of the propagation of optical radiation of different wavelengths in the atmosphere. G. GOEBEL. *Fernmeldtech. Z. [FTZ]* **3**, 43-7 (Feb., 1950) In German.

Observations are made on the effect of temperature

variation, air-motion and humidity on a communication system using modulated light. The transmitter consists of a high-pressure Hg-vapour lamp controlled by a Duddell modulator. Reception is by 3 photocells and 4 filters in order to cover the range from the infra-red to the ultra-violet. A 16 mm camera is used to record the instrument readings. It was found that under normal conditions of communication, propagation was independent of wavelength. Pronounced temperature variations, air motion and heat scintillation were without effect. Reliable communication through fog is predicted for a receiver fitted with a.g.c.

S. C. DUNN (R)

551.594

7651. Observations of the atmospheric electric field at Monaco. J. ROUCH. *C.R. Acad. Sci., Paris*, **230**, 1485-7 (April 24, 1950) *In French*.

269 observations were made at midday during the year, in varying cloud amounts but without rain, of the atmospheric electric field at a height of 70 m at Monaco. Values varied from below 150 to above 1 000 V/m with a mean of 306 V/m. Values were greater with clear than cloudy skies. Monthly and seasonal means show a maximum in winter, and a minimum in summer.

R. S. READ

551.594.11

7652. A radiosonde method for potential-gradient measurements in the atmosphere. K. KREIELSHEIMER. *N.Z. Sci. Congress* (1947), 91-8.

The method is a simple modification of the Bureau of Standards radio-meteorograph. The calibration of the instrument, a typical record obtained and the further extension of the work, are discussed.

A.

551.594.12 : 551.510.53

7653. The ionization of the stratosphere above tropospheric high and low pressure regions. G. FALCKENBERG AND E. LAUTER. *Z. Met.*, **3**, 136-40 (May-June, 1949) *In German*.

The absorption in the ionized stratosphere of the space wave of 1 250 m broadcast from Kalundborg and reflected by the E-layer was studied on 650 nights by noting the percentage of time that it fell below a given ratio to ground wave. Frequency distribution shows two peaks at 50 and 15%, and is resolved into two Gaussian curves and a remainder. Relation to tropospheric lows (great absorption) and stratospheric highs (small absorption) is compared to broad-weather situation and tendency of 500 mb surface. Remainder represents periods of great absorption which may be due to extra-terrestrial influences or magnetic disturbance.

METEOROLOGICAL ABSTRACTS

551.594.13 : 551.591

7654. On the influence of meteorological factors on atmospheric conductivity. E. VON KILINSKI. *Z. Met.*, **3**, 46-9 (Jan.-Feb., 1949) *In German*.

Electrical conductivity increases with visibility up to 29 km, then constant. It decreases with increasing relative humidity, especially near saturation; in both these relations ion adsorption plays an important part. Conductivity increases with temperature up to 20-30°C because of increased release of air from soil; a possible decrease above 30° may be due to vertical currents.

METEOROLOGICAL ABSTRACTS

551.594.2

7655. Atmospheric electricity during disturbed weather. G. SIMPSON. *Geophys. Mem. Met. Off.* (No. 84) 51 pp. (1949).

Disturbances of potential gradient are related to ascending currents in upper atmosphere; they are usually irregular but sometimes form regular oscillations (cause unknown). When gradient exceeds 20 V/cm, charge on rain or snow is proportional to gradient but of opposite sign. Author suggests that charge on precipitation is mainly derived from point-discharge currents, partly by sweeping up ions. With potential gradients negative, <10 V/cm (normal fine-weather gradient at Kew 3-4 V/cm) charge on rain is + and proportional to depression below normal. Charge on snow is -, gradient normal.

METEOROLOGICAL ABSTRACTS

551.594.22 : 621.316.98

7656. The properties of artificial lightning discharges against a geologically heterogeneous surface. H. NORINDER AND O. SALKA. *Conf. Int. Gr. Rés. Elect.* [CIGRE] Paper 313, 19 pp. (1950).

The properties of positive and negative discharges against a geologically heterogeneous surface are analysed by model experiments at the Institute of High Tension Research in Uppsala, Sweden. The cause of the different behaviour of the two polarities must be sought in the different mechanisms of the formation of discharge. Assuming that the events of discharge are analogous in nature and in the laboratory, it is allowable to transfer the results of model experiments to natural lightning. According to this the following ideas are obtained. The question of the existence of lightning nests must be answered in the affirmative. They exist only in geologically heterogeneous terrain. The polarity of lightning plays the leading role. Positive lightning has a strongly marked tendency to go to places with good electrical properties, it easily forms lightning nests, which are always situated at the contact-zone between good and poor geological conductors. If positive lightning is situated at a greater distance from the contact-zone, creeping discharges are possible. Negative lightning is insensitive to a geological discontinuity. It is not possible to direct negative lightning even with good conducting components. Negative lightning at small distances from the contact-zone does not hit exclusively places with good conducting subsoil, but its strokes are scattered also over the surroundings having poor conductivity. The tendency to creeping strokes is feebly marked in the case of negative lightning.

A.

551.594.221

7657. The effect of geological discontinuities on artificial lightning discharges as studied in a model test arrangement. H. NORINDER AND O. SALKA. *Ark. Geofys.*, **1**, Paper 3, 45-78 (1950).

Impulses are applied to a tank filled with a uniform mixture of sand, or alternatively with various metallic enclosures or a metal vein in the sand. The points at which the sand surface is struck are plotted for the various test arrangements and for both impulse polarities. For an explanation of the results obtained, a photographic investigation is made, with a rotating

camera, of long +ve and -ve sparks, confirming the results obtained by earlier investigators [T. E. Allibone and J. M. Meek, *Proc. Roy. Soc., A*, **166**, 97-126 (May 4, 1938)]. On the basis of these tests the model test results are interpreted and it is concluded that the geological structure of the subsoil influences the path of a +ve lightning stroke but exerts no noticeable effect on -ve strokes. The question of the validity of the results obtained for an interpretation of natural lightning phenomena is only briefly dealt with.

R. H. GOLDE

551.594.5

7658. On the infrared radiation of northern lights. S. F. RODIONOV AND L. M. FISHKOVA. *Dokl. Akad. Nauk, SSSR*, **70** (No. 6) 1001-3 (1950) *In Russian*.

A photometric investigation of the near-infrared spectrum of northern lights has been carried out in order to elucidate the radiation in the region 1.02-1.04 μ which had been investigated by several authors. A previously described photometer [Osherovich, Pavlova, Rodionov and Fishkova, *J. Tech. Phys., USSR*, **19**, 184 (1949)] has been used. It has been found that northern lights display a radiation between 900-1 080 $m\mu$ which is 20-30 times as intense as the green line.

F. LACHMAN

551.594.5

7659. New researches on the spectrum of aurora borealis. L. VEGARD. *C.R. Acad. Sci., Paris*, **230**, 1884-6 (May 22, 1950) *In French*.

From a single spectrogram, obtained Feb. 23-24, 1950, exposure 10 h at $f:1.2$ on Eastman 103-a T plate, 114 separate lines and bands have been measured in the interval, 3 900-6 100 Å. Of these, 54 are new features, whilst 44 radiations observed previously do not appear. Bands of O_2^+ are identified for the first time, and the obsd. displacement of $H\beta$ to the violet indicates a rapid downward movement of H atoms in the auroral discharge. From measures of individual lines in the 3 914 Å rotational band of N_2^+ , a temperature $\sim 219^\circ K$ is indicated—a value lower than the mean of previous estimates.

D. R. BARBER

551.594.5 : 538.561

7660. On the origin of ten centimeter radiation from the polar aurora. P. A. FORSYTH, W. PETRIE AND B. W. CURRIE. *Canad. J. Res., A*, **28**, 324-35 (May, 1950).

Short-lived bursts of 10 cm radiation from auroral displays have been received by radar equipment. The sources of continuous radiation from a partially ionized medium are briefly discussed. From a knowledge of the constants of the equipment used it is deduced that the power density at the receiver is at least 2×10^{-10} watts per (meter)², and it seems that the most likely source of this radiation is a plasma oscillation of the ionized volume associated with the auroral display. If this is so, the electron density in at least localized regions must be of the order 10^{11} per cm^3 .

A.

551.594.51

7661. An auroral spectrogram obtained at Oslo on February 23. L. VEGARD. Letter in *Nature, Lond.*, **165**, 1012-13 (June 24, 1950).

From the spectrogram obtained by a specially-designed spectrograph 114 lines and vibrational

bands in the range 3 900-6 300 Å, including 54 previously unobserved, have been measured with an error of less than one ångström, enabling many unambiguous identifications to be made. The results show that the O I, O II, N I and N II states occur in the ionosphere. Attention is directed to: (a) the line 5 198.3 Å as the forbidden N I-doublet $^4S_{3/2} - ^2D_{5/2, 3/2}$; (b) a doublet corresponding to a group of N II lines between 5 001-5 005 Å; (c) the absence of the O III nebular line 5 007 Å and (d) the O I line 4 368.3 Å. Rapid downward motions are indicated by the displacement of the broad $H\beta$ line. The separation of the rotational components of the R-branch of the negative nitrogen band 3 914 Å yield an estimate of ionospheric temperature of $219.9^\circ K$ from the position of maximum intensity and $217.9^\circ K$ from the intensity distribution.

M. W. OVENDEN

551.594.6 : 523.75

7662. Ionospheric effects of solar flares. R. LINDQUIST. *Trans. Chalmers Univ. Tech. Gothenburg* (No. 95) 11 pp. (1950).

Summary, in graphical and tabular form, of the regular recordings of radio fade-out phenomena made in Sweden during the period July 1948-June 1949.

W. J. G. BEYNON

551.594.6 : 538.566

7663. The microstructure of atmospherics. Ionospheric and meteorological applications of those of type 4. R. RIVAUT. *C.R. Acad. Sci., Paris*, **230**, 1846-7 (May 22, 1950) *In French*.

Summary of observations of atmospherics of a particular type made daily at the hours 1700-2100 during October 1949. Certain differences in the form of the received atmospheric with meteorological conditions at the source are briefly noted. The mean level of reflection of the signals in the ionosphere is given as 75 km, with marked changes at the time of magnetic storms. [For earlier work see R. Rivaut, *C.R. Acad. Sci., Paris*, **221**, 540 (1945)].

W. J. G. BEYNON

551.594.6 : 551.510.535

7664. On the reflection of atmospherics from the ionosphere at night. II. M. W. CHIPLONKAR AND M. S. HATTIANGADI. *Proc. Indian Acad. Sci., A*, **30**, 223-36 (Nov., 1949).

Further account of work in India on atmospherics [see Abstr. 1752 (1946)]. Information obtained concerning the height and reflection coefficient of the reflecting layer, the distance of the sources of atmospherics, the duration and character of the pulses, etc., are briefly described and discussed.

W. J. G. BEYNON

551.594.6 : 551.571.4

7665. Low-level atmospheric ducts. R. F. JONES. Letter in *Nature, Lond.*, **165**, 971 (June 17, 1950).

See Abstr. 3613 (1949). Investigation of the previous history of the air on each of eleven days supports the author's hypothesis.

551.594.6 : 621.396.11

7666. Determination of modified index-of-refraction over the Gulf of Mexico from radio data. A. W. STRAITON AND A. H. LAGRONE. *J. Appl. Phys.*, **21**, 661-6 (July, 1950).

This paper presents the results of measurements of the signal strength and phase of 3.2-centimeter

radio waves for a 26.5-mile path over the Gulf of Mexico under a variety of meteorological conditions. The radio data are used to determine the modified index-of-refraction as a function of height and the associated attenuation factor. The modified index-of-refraction curves are compared to those measured meteorologically. A.

551.594.6 : 621.396.821

7667. On the recording of the mean level of atmospheric. F. CARBENAY. *C.R. Acad. Sci., Paris*, 230, 1648-50 (May 8, 1950) In French.

Note on the construction of a 27 kc/s atmospheric recorder which gives the average field intensity of the incident signals. W. J. G. BEYNON

BIOLOGY 57/59

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612.84

7668. Colour filters, colour blindness and colour vision. U. EBEBCKE. *Experientia*, 6 (No. 4), 126-34, 1950) In German.

Artificial colour-blindness produced by placing a colour filter before the eye, and by means of coloured illumination in a dark room, shows that an absorptive or receptive visual defect never results in red-blindness or green-blindness alone, because the general chromatic tone of the visual field is confused with white. The experiments are related to the general theory of colour vision with special reference to the photochemical data on sensitizing pigments decomposed by light and to central nervous regulation (antagonistic effects in reciprocal innervation). A.

612.84

7669. Dark adaptation level and size of testfield. E. WOLF AND M. J. ZIGLER. *J. Opt. Soc. Amer.*, 40, 211-18 (April, 1950).

Data for dark adaptation curves were obtained for 4 square fields, subtending respectively 2.5, 5, 10, and 20 degrees at the eye, (a) when the subject indicated when light could just be perceived, and (b) when parallel fine lines could just be detected. The levels attained in both the cone and in the rod segments of this function were found to vary when the area of the testfield exposed to the eye was changed, being higher for a smaller than for a larger testfield. This denotes that sensitivity is greater for a larger than for a smaller field of retinal stimulation. These findings indicate that the limit between so-called photopic and scotopic vision is not to be regarded as fixed and definite but as functionally variable. A.

612.84

7670. On the variation of the amplitude of accommodation of the human eye with the region of the pupil used. A. IVANOFF. *C.R. Acad. Sci., Paris*, 230, 1896-7 (May 22, 1950) In French.

The amplitude of accommodation, as measured with a Badal optometer, is 6.4 dioptries on the axis, and 5.2D 1.5 mm away from it. Each point on the graph is the mean of 20 results: the temporal and nasal sides are dissimilar. The variation is explained on the basis of the spherical aberration of the eye.

R. A. WEALE

612.84

7671. Brightness sensitivity of the eye for two

luminous points. F. FLAMANT. *C.R. Acad. Sci., Paris*, 230, 1977-9 (May 31, 1950) In French.

The least perceptible intensity difference between 2 points (dia. 7.4") was determined as a function of their distance apart, their retinal position and their hue (white, $\lambda > 0.63$, 0.546 and 0.436 μ). When the eye fixates a point bisecting their distance d apart, the differential threshold sensitivity rises to a maximum when $d = 12'$ and then decreases. When these points move along the circumference of a circle so as to contain homogeneous foveal regions, the sensitivity remains constant. For a constant separation of 10' the sensitivity is the same of red, green and white, being maximal at the foveal centre: it is reduced at $\approx 10'$ and then remains constant to 40' off centre. Here there occurs a sharp discontinuity: it is constant to 2° off centre and then diminishes. Blue has a minimum at the centre and a maximum between 10 and 40': there is a diminution up to 2°. A table is given. R. A. WEALE

612.84 : 525.722 : 551.593.122

The scintillation of stars. See Abstr. 7645-6

615.84 : 621.396.91

7672. Ultra-short-wave therapy with decimetre and centimetre waves. K.-H. SPILLER. *Elektrotech. Z. [ETZ]* 71, 27-30 (Jan. 15, 1950) In German.

The most important features of thermal therapy using electromagnetic radiation in the dm- and cm-band are the concentration of the load in muscular tissue to its exclusion in fatty tissue. Furthermore, the fact that the radiation observes the optical laws enables the therapist to employ paraboloidal or ellipsoidal mirrors to obtain maximum effects by utilizing optical reflection. Concentrating lenses for use with cm-waves must be bi-concave. The temperature rise has its maximum not in the focus of the optical arrangement but at some distance in the direction away from the lens. W. SUMMER

615.849

7673. Biological evaluation of 20 million volt roentgen rays. IV. Efficiency and dosage range. H. QUASTLER AND E. F. LANZL. *Amer. J. Roentgenol. and Radium Ther.*, 63, 566-74 (April, 1950).

The efficiency of 20 MeV betatron radiation compared to 200 kV radiation is a function of (1) the two kinds of radiation, (2) the particular reaction to radiation considered, (3) the unit in which the radiations are measured. By conducting two experiments at different dosage levels, with factor (3) constant, the biological factor was distinguishable in the relative

efficiencies. The test reaction was the lethal effect of fractionated whole-body doses on mice. Four equal groups of mice were used (with corresponding controls). Two groups were irradiated daily at dosage 80-100 "r" (Victoreen chamber) from 20 MeV and 200 kV respectively; the other two groups received 350-450 "r" respectively from each radiation. Statistical analysis of results showed: at the higher daily dosage, 20 MeV rays are about as efficient in fractionation as in single massive dose, and do not differ significantly from 200 kV rays. At the lower daily dosage, efficiency relative to 200 kV rays is significantly lowered. Lower relative efficiency of 20 MeV X-rays at small doses is then compared to the higher relative efficiency of neutrons under similar conditions.

D. V. MABBS

615.849

7674. Comparison of dosage distributions obtainable with 400 kVp X-rays and 22 MeV X-Rays. H. E. JOHNS, E. K. DARBY, T. A. WATSON AND C. C. BURKELL. *Brit. J. Radiol.*, **23**, 290-9 (May, 1950).

A 22-MeV betatron has been used for a year at Saskatchewan University for nuclear research and medical research. A description is given of the method of collimating the radiation beam, the area of which is controlled by insertion or removal of Pb plugs of appropriate diameter. Measurements of the dosage distribution were made with a water phantom and ionization chamber previously described, references being given. A Cu compensating filter allowed constant distribution of dose over treatment fields of 10 cm at 70 cm F.S.D. and

15 cm at 105 cm F.S.D. Larger fields would be possible by use of a greater F.S.D. The apparatus used necessitated the patient being orientated to the X-ray beam, but future apparatus is foreshadowed, whereby the betatron will be mobile and orientated to the patient. Isodosis curves are given for multiple directions of irradiation and 3-field radiation gives a depth dose several times the maximum skin dose. The "flat" isodosis curves which are obtained allow simple multiple field arrangements and the integral dose for a given tumour dose and volume is much less than with conventional X-rays, comparison being made with 400 kVp X-rays, whilst homogeneity of dose throughout the tumour volume can be obtained within a few per cent. As depth dose is independent of field size clinical application is simplified and the high output of the apparatus shortens the time of treatment, which is about 100 "r"/min. An objection is a loud whining noise which can be reduced below 92 decibels by use of acoustic tiles, the noise then impressing patients rather than causing dismay.

B. J. LEGGETT

615.849 : 537.531.08 : 621.386.82

Marconi-Farmer X-ray dosimeter. *See Abstr.* 7283

615.849 : 537.533.75

Physical action and biological effects on objects irradiated with fast electrons. *See Abstr.* 7304

616.12-7 : 518.7

A trigonometric computer with electrocardiographic applications. *See Abstr.* 6941

TECHNICAL MATERIALS 66/67

666 : 541.133 : 537.311.32

Electrolytic conduction in glass. *See Abstr.* 7238

666.1

7675. Preparation of alkali metals in glass. D. K. C. MACDONALD AND J. E. STANWORTH. Letter in *Proc. Phys. Soc., Lond. B*, **63**, 455-6 (June, 1950).

669

7676. Nickel and its alloys. *Circ. Nat. Bur. Stand., Wash.* (No. 485) 72 pp. (1950).

Sources, metallurgy, chemical, physical and mechanical properties, casting and machining characteristics, etc., are given for Ni and ferrous and non-ferrous alloys. Bibl. 402 refs.

INDEX AERONAUTICUS

PHOTOGRAPHY 77

77.01 : 541.14

The spontaneous regression of the photolysis of silver bromide. *See Abstr.* 7568

771.534

7678. On the increase of spectral sensitivity at 3500 Å observed with pure silver bromide emulsions.

A. VASSY AND E. VASSY. *C.R. Acad. Sci., Paris*, **230**, 1266-8 (March 27, 1950) *In French*.

- Different emulsions were prepared by varying the amounts of AgNO₃ and NH₄Br used. It was found that the emulsion for which the highest percentage of bromide was used gave the maximum increase in

sensitivity. Some experiments were also made on the effect on sensitivity of varying the ripening time.

A. HARVEY

771.534

7679. Spectral sensitivity of two commercial X-ray films between 0.2 and 2.5 Angstroms: H. E. SEEMANN. *Rev. Sci. Instrum.*, **21**, 314-22 (April, 1950).

The spectral sensitivities of Kodak No-Screen and Kodak Industrial Type K X-Ray Films were determined in the region between 0.2 and 2.5 Å using the filtered *K* fluorescence of several irradiated elements as approximately homogeneous radiation. Exposures in roentgens were obtained with an air ionization chamber designed especially for the purpose. Curves are given showing the number of roentgens incident on the film which will give a developed photographic density of 1.0 above fog for the various wavelengths. The *K* limits of Ag and Br are prominent. The maximum sensitivity in terms of roentgens occurs at about 0.4 Å, but the marked decrease found by other observers at shorter wavelengths is probably obscured by inaccuracies. From the energy value of the roentgen, the sensitivity of the films is expressed as the incident ergs per cm² required to produce a density of 1.0 above fog. Computations from these results show that as the wavelength increases the films utilize the absorbed energy more efficiently. On the other hand, high energy quanta are more efficient than low energy quanta but not in proportion to their energy. In addition to the more or less gradual change with wavelength of efficiency of utilization of absorbed energy, there is evidence for sudden jumps at the *K* limits of Ag and Br. Qualitative explanations are given for the observed changes in efficiency. A.

771.534 : 778.3

7680. Gold sensitization of X-ray films. H. HOERL AND F. W. H. MUELLER. *J. Opt. Soc. Amer.*, **44**, 246-51 (April, 1950).

Sensitization of non-screen type X-ray emulsion with aqueous solutions of ammonium or alkali aurothiocyanates leads to a wavelength-dependent increase of their X-ray and γ -ray sensitivities. For a particularly fine-grain emulsion the gain in photographic speed is shown to increase from a factor of 1.5 at 1.3 Å to a factor of 10 at 0.011 Å. This wavelength-dependence of the sensitizing effect is governed by the range-energy relationship of electrons, by the shape of the energy loss curve of electrons, and the threshold sensitivity of the average grain. The sensitivity of the average grain in an unsensitized and an Au sensitized emulsion was derived from the number of quanta required to produce the same photographic effects at different wavelengths. Au sensitization caused an increase in threshold sensitivity from $(6 \text{ keV})^{-1}$ to $(1.2 \text{ keV})^{-1}$ for the average grain of the emulsion under investigation. A comparison of the quantities of latent image Ag formed by light exposure on one hand, and by electrons on the other, indicates that Au sensitization increases the effective radius of action of the sensitivity centres and also the number of active centres at the grain surface. A.

778.3 : 537.533.9

Particle identification in photographic emulsions by the delta-ray method. See Abstr. 7306.

778.3 : 539.177

The possibility of electromagnetic excitation of the nuclei in photographic emulsions by light fast nuclei See Abstr. 7491

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